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STATISTICAL SUMMARY OF WATER SUPPLY AND TREATMENT PRACTICES IN THE UNITED STATES

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Statistical Summary of Water Supply and Treatment Practices in the United States*

By JOHN R. THOMAN, Senior Sanitary Engineer

FOREWORD

This report summarizes and discusses data on public water supply and treatment facilities in the United States based on the 1948 Inventory of Water and Sewage Facilities (unpublished). Supplemental data of a statistical nature have been gathered from various sources for the purpose of comparison and the development of trends.

Historical Background

During 1939 the Public Health Service, in cooperation with the various State Health Departments, initiated a program designed to furnish a continuing census of sewage disposal systems and water treatment plants in the United States. These activities were conducted at the Environmental Health Center, Cincinnati, Ohio, until 1950, when they were transferred to the Division of Water Pollution Control, Washington, D. C.

In 1943, a tabulation of untreated water supplies was started to supplement those data already available, and as of 1945 all of the data were collated on a single form. This information was published in 1948 (*1*). Annual editions with necessary revisions were prepared for 1947 and 1948, but they were not published. (For a more complete discussion of Inventory development see Supplement 213, Public Health Reports (*2*).)

A summary of the 1940 Inventory data on water treatment plants has been published (*3*) and data on all public water supplies were compiled by *Engineering News-Record* (*4*) in 1939. Earlier statistical summaries of water supply practice include those by a committee of the Conference of State Sanitary Engineers (*5*) and by Gillespie (*6*). Both were confined to treatment plants, and Gillespie's summary was further restricted as to size of plant included.

I. BASIC DATA

Sources

The basic Inventory tabulation used to prepare this summary provided detailed information for all incorporated communities of over 100 popula-

*Published by the Division of Water Pollution Control, Washington, D. C.

tion and all unincorporated communities of over 500 population. Publications of the Census Bureau were used as the source list of communities. In many instances data for unincorporated areas not listed by the Census Bureau were added at the request of the State Health Department concerned. Population estimates for these communities were obtained from the 1940 edition of the Rand-McNally Commercial Atlas.

Water supply data furnished by the Inventory include the following: estimated population served, ownership, source of supply, rated capacity and average daily output, symbolized statement of treatment, type of laboratory control and distribution system storage, both gravity and repumped. These data, with the exception of storage information, were entered on marginal punch cards for tabulation and analysis.

To allow for better comparison, earlier statistical data have been resummarized in accordance with criteria used in this report. The basic information used by Weibel (*3*), Streeter (*5*), and Gillespie (*6*) were available, and were so treated.

A literature search was conducted to bring to light other older statistical data of value. In addition to the three sources listed above, valuable information was found in the *Engineering News-Record* (*4*), Turneaure & Russell (*7*), *The Manual of American Water Works Practice* (*8*), and Olson (*9*), (*10*).

Methods

For purposes of tabulating the data, the cards for each State were broken down into eight population groups as follows:

Group	*Population range*
1	Less than 500
2	500–1,000
3	1,000–5,000
4	5,000–10,000
5	10,000–25,000
6	25,000–50,000
7	50,000–100,000
8	More than 100,000

These population groups are the same as were used in the Summary of Sewage Works data (*2*), and have been generally adopted for most statistical summaries of this nature. Detailed tabulations by population groups for each State are not included in this report, because of the number of tables involved and the questionable significance of the data when considered in such small segments.

In addition to State and community population group listings, basic data are shown by geographical areas. The areas are those currently used by the Census Bureau, and, in general, include States affording some homogeneity of economical, industrial and social patterns. They are a standard division,

and, as such, permit comparison with statistical data of various types from many sources. The States included in each area are as follows:

Area	*States*
New England	Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.
Middle Atlantic	New York, New Jersey, Pennsylvania.
South Atlantic	Delaware, Maryland, D. C., Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.
East North Central	Ohio, Indiana, Illinois, Michigan, Wisconsin.
East South Central	Kentucky, Tennessee, Alabama, Mississippi.
West North Central	Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas, Missouri.
West South Central	Arkansas, Louisiana, Oklahoma, Texas.
Mountain	Montana, Wyoming, Idaho, Colorado, Utah, Nevada, New Mexico, Arizona.
Pacific	Washington, Oregon, California.

Summary data on rated capacity and average daily output of water supplies are not included in this report. Such data are lacking in many instances. This, and the need for further study of methods for summarizing such data, indicated the desirability of proceeding with the summary as presently prepared.

Summarized water facility data included in this report are from the 1948 Inventory of Water and Sewage Facilities in the United States. The 1945 Inventory for the States of Wisconsin and Utah was the latest available and represents the only major departure from conditions existing at the end of 1948.

Where estimated populations served were not available from the Inventory, the data were supplied by the following arbitrary procedures: (*a*) for those States in which only a few figures were lacking, the 1940 census populations, rounded to the nearest 10, were used, (*b*) when many data were lacking, a factor was applied to the census population which was based on experience in communities of the same population group in that State for which data were available. It was necessary to use the procedure outlined in (*b*) above, in only three population groups in each of three States. The population served data reported in the Inventory are quite complete, and represent the most complete compilation that has been available. Heretofore, gaps have existed in such information, and all previously published summaries have necessarily been based on incomplete data. These facts should be borne in mind in assessing comparative data reported herein.

Only all regularly used supplies are included in this summary. Seasonal, auxiliary, and emergency supplies and/or treatment works are not included.

Percentages are based on the total of the available data in the category under consideration. Percent changes were computed in accordance with usual practice according to the formula:

$$\text{Percent change} = \frac{\text{Data for later year minus Data for earlier year}}{\text{Data for earlier year}} \times 100$$

Tabular Summaries

The data are presented in tables giving national summaries of source of supply and treatment, treatment plants, disinfection and selected unit processes (tables 1 through 4). Detailed statistics by States, population groups, and geographical areas appear in tables 5 through 13.

Table 1. *General water works summary for the United States—by communities, ownership and estimated population served*

	Number	*Percent*
Communities—total	16,747	100.0
— served by ground sources	10,820	64.6
— served by surface sources	4,963	29.6
— served by both ground and surface sources	964	5.8
— served by treated supplies	9,078	54.2
— served by untreated supplies	7,239	43.2
— served by both treated and untreated supplies	385	2.3
— unknown	45	.3
Ownership—total number of communities	16,439	100.0
— public	11,326	[1] 68.9
— private	4,992	[1] 30.4
— both public and private	121	[1] .7
Estimated population served—total	93,455,135	100.0
— from ground sources	24,273,030	26.0
— from surface sources	51,066,015	54.6
— from both ground and surface sources	18,116,090	19.4
— by treated supplies	74,403,365	79.6
— by untreated supplies	8,694,265	9.3
— by both treated and untreated supplies	10,311,135	11.0
— unknown	46,370	.1

[1] Percent of total for those communities for which data are available.

Table 2. *Summary of treatment plants for the United States classified by plant function*

Plant classification	Number of plants	Estimated population served	Number of plants	Estimated population served
			Percent of total	*Percent of total*
Rapid sand purification:				
Purification (only)	1,753	33,877,100	25.0	40.6
Purification and softening	188	4,927,495	2.7	5.9
Purification and iron and manganese removal	17	197,115	.3	.2
Purification, softening, and iron and manganese removal	12	283,750	.2	.4
Slow sand purification	84	2,014,635	1.2	2.5
Softening	345	1,931,595	4.9	2.3
Iron and manganese removal	578	2,531,875	8.3	3.0
Softening and iron and manganese removal	234	712,455	3.3	.9
Chlorination:	3,069		43.9	
Simple	517	36,113,500	7.4	43.4
With some miscellaneous process	189	663,650	2.8	.8
Miscellaneous				
Total	6,986	83,253,170	100.0	100.0

Tables 5 through 10 contain data on number of communities and population served for various items, while tables 11 through 13 contain data by numbers of treatment plants in addition to population data.

Table 5 shows the 1940 Census population of those communities served by public water supplies. In the majority of cases, this figure is exceeded by the population served. This is largely due to the time factor involved

Table 3. *Summary of waterworks disinfection practice for the United States—classified by type of disinfecting agent*

Type of disinfection	Number of plants	Estimated population served	Number of plants	Estimated population served
			(*Percent of total*)	
Liquid chlorine	3,613	41,263,720	58.9	51.2
Hypochlorite	1,557	1,667,275	25.4	2.1
Ammonia—chlorine	702	33,529,435	11.4	41.6
Both liquid chlorine and hypochlorite	37	332,045	.6	.4
Unreported method	226	3,723,250	3.7	4.6
Other	2	117,200	< .1	.1
Total	6,137	80,632,925	100.0	100.0

between the 1940 Census figures and the 1948 population served data. The data on system ownership do not equal the total number of communities having supplies. This is due to a lack of information for about 300 communities.

Certain data in tables 6 through 10, have been repeated where necessary to permit the information to be compared in more than one way, and to furnish total data without reference to a previous table. In table 8 for the State of Utah and in table 9 for the State of Virginia, one community is shown as being served by a treated and untreated supply, but no population served is shown. In each case, the particular community is served by water supplies of two other communities; one of which furnished treated water, the other untreated. The population served, therefore, is listed under the primary supplying communities. This type of situation occurred in such few instances that no special procedure was adopted for handling it.

Table 11 contains data on treatment plants by functional classes. The classes employed are used as a basic classification in the Inventory, and represent a description of the general function for which the plant was designed. In all cases, plants were classified by the State Health Department reporting the data. The functional classes utilized in this report are the same as those used by Weibel (*3*). In most instances, the class entitled "Purification" refers to plants incorporating filters. Frequently filters are

Table 4. *Summary of some water treatment processes used in the United States*

Unit treatment process	Number of plants using process*	Estimated population served
Filters:		
Rapid—sand	2,106	39,137,710
Slow—sand	117	3,539,035
Pressure	616	2,394,255
Rapid—(anthrafilt)	52	1,437,060
Softening:		
Lime—soda	481	7,485,045
Zeolite	298	869,250
Aeration	1,518	17,684,020
Taste and odor control	717	18,568,795
Corrosion control	980	18,135,195

*Plants using more than 1 process are included in total of each process.

Table 5. *General summary of communities, population served, and ownership of community water supplies*

Population groups, States, and geographical areas	Total number of communities	1940 census population of communities having supplies	Estimated population served	Estimated population served by other communities	Ownership—number of communities		
					Public	Private	Both public and private
POPULATION GROUPS							
Less than 500	4,263	1,286,557	1,272,725	.....	2,420	1,768	16
500–1,000	4,170	3,030,913	2,843,210	.....	2,929	1,147	17
1,000–5,000	6,047	13,063,179	12,689,225	.....	4,320	1,550	33
5,000–10,000	1,126	7,782,609	7,907,860	.....	794	297	21
10,000–25,000	719	10,797,553	11,203,720	.....	528	162	21
25,000–50,000	221	7,661,877	8,381,725	.....	167	45	5
50,000–100,000	108	7,397,907	8,353,305	.....	90	15	2
More than 100,000	93	38,152,359	40,803,365	.....	78	8	6
STATES							
Alabama	314	1,156,986	1,547,035	209,805	187	126	.....
Arizona	88	257,230	413,455	6,705	31	56	.....
Arkansas	184	578,110	[30] 776,930	52,460	140	44	.....
California	[1] 490	5,452,357	7,164,105	964,425	319	166	6
Colorado	207	716,177	802,345	23,380	188	13	.....
Connecticut	196	1,499,905	[23,40] 1,697,290	473,425	50	119	4
Delaware	40	173,885	201,995	9,495	25	13	.....
District of Columbia	1	663,091	[41] 772,000	.....	1	.....	.....
Florida	[2] 339	1,287,746	1,673,190	138,875	180	149	7
Georgia	356	1,453,844	[26] 1,380,360	125,945	304	47	.....
Idaho	174	265,215	312,510	100	131	41	1
Illinois	712	6,324,949	[27] 6,130,460	523,305	664	46	1
Indiana	366	2,171,638	[18,28,42] 2,121,405	25,260	291	67	.....
Iowa	[3] 587	1,477,785	[19,29] 1,385,610	11,830	572	14	.....
Kansas	384	984,707	[43] 1,037,615	2,980	368	15	.....
Kentucky	301	1,117,981	[20,44] 1,169,325	107,145	182	116	.....
Louisiana	221	1,212,767	1,459,475	62,230	126	77	1
Maine	193	625,256	[45] 602,370	105,440	83	109	.....
Maryland	[4] 159	1,371,815	[46] 1,361,020	268,765	106	48	.....
Massachusetts	263	4,221,718	[31] 4,222,175	1,621,700	214	43	2
Michigan	458	3,946,634	3,848,970	343,775	370	85	1
Minnesota	[5] 510	1,711,020	1,594,840	26,330	486	23	.....
Mississippi	216	583,283	642,000	.....	164	48	.....
Missouri	355	2,302,239	2,242,715	277,305	265	88	.....
Montana	115	290,426	305,270	8,980	90	22	1
Nebraska	410	756,597	[47] 703,570	1,400	407	3	.....
Nevada	38	75,732	82,205	6,000	22	16	.....
New Hampshire	[6] 118	367,530	[32] 347,875	9,545	53	24	1
New Jersey	[7] 451	3,979,003	3,930,935	1,590,265	193	216	39
New Mexico	97	233,112	335,560	6,005	62	34	.....
New York	[8] 1,261	12,434,182	[20,33] 12,329,960	903,610	798	435	16
North Carolina	360	1,333,238	1,490,670	97,965	288	62	.....
North Dakota	111	219,735	201,590	.....	108	2	.....
Ohio	621	5,084,477	[21,34,48] 5,063,675	700,690	556	53	.....
Oklahoma	348	1,119,886	[22,35] 1,139,880	9,135	325	21	.....
Oregon	[10] 340	719,378	945,030	67,065	231	105	4
Pennsylvania	[11] 1,613	8,412,152	[49] 8,041,055	2,377,355	497	1,038	20
Rhode Island	[12] 74	733,104	[50] 685,555	[1936] 665	19	46	.....
South Carolina	232	721,328	908,030	86,25..	131	69	.....
South Dakota	195	276,248	263,260	300	189	4	.....
Tennessee	[13] 220	1,196,908	[51] 1,201,185	26,195	14.	64	.....
Texas	[14] 930	3,602,887	[36] 4,287,210	65,025	619	300	3
Utah	[15] 200	410,335	440,890	6,250	144	54	.....
Vermont	156	211,844	206,755	5,490	76	75	4
Virginia	[16] 411	1,206,974	[37] 1,497,560	93,370	190	216	2
Washington	[17] 359	1,176,813	[24] 1,475,970	36,550	242	110	3
West Virginia	551	964,193	[24,38,52] 936,940	104,720	110	432	3
Wisconsin	352	1,949,016	1,925,775	94,610	326	25	1
Wyoming	70	141,518	149,535	13,050	56	13	1

See footnotes at end of table.

Table 5. *General summary of communities, population served, and ownership of community water supplies*—Continued

Population groups, States, and geographical areas	Total number of communities	1940 census population of communities having supplies	Estimated population served	Estimated population served by other communities	Ownership—number of communities		
					Public	Private	Both public and private
GEOGRAPHICAL AREAS							
New England	1,000	7,659,357	7,762,020	2,402,265	495	416	11
Middle Atlantic	3,325	24,825,337	24,301,950	4,871,230	1,488	1,689	75
South Atlantic	2,449	9,176,114	10,221,765	925,390	1,335	1,036	12
East North Central	2,509	19,476,714	19,090,267	1,689,640	2,207	276	3
East South Central	1,051	4,055,158	4,559,545	343,145	680	354	.....
West North Central	2,552	7,728,331	7,429,200	320,145	2,395	149	.....
West South Central	1,683	6,513,650	7,663,495	188,850	1,210	442	4
Mountain	989	2,389,745	2,841,770	70,470	724	249	3
Pacific	1,189	7,348,548	9,585,105	1,068,040	792	381	13
Total	16,747	89,172,954	93,455,135	11,879,175	11,326	4,992	121

The number of communities listed have not been included for the following reasons:

[1] 10—no source and/or treatment detail.
[2] 10—unincorporated places served by Pinellas County Water System.
[3] 2—insufficient population data.
[4] 5—insufficient population data.
[5] 2—no source and/or treatment detail.
[6] 2—insufficient population data.
[7] 1—insufficient population data.
[8] 20—insufficient population data—all are served by other communities.
3—no source and/or treatment detail.
[9] 1—no source and/or treatment detail.
[10] 44—insufficient population data. 26 are served by other communities.
1—no source and/or treatment detail.
[11] 8—insufficient population data—all are served by other communities.
[12] 5—insufficient population data—all are served by other communities.
[13] 2—insufficient population data—both are served by other communities.
[14] 5—insufficient population data.
4—no source and/or treatment detail.
[15] 3—no source and/or treatment detail.
[16] 3—served by military supplies.
[17] 3—insufficient population data.
1—no source and/or treatment detail. Richland counted in 10,000–25,000 population group.

The following population served by institutional or other semi-public facilities are included in col. (4) and in the details of source and treatment. The populations have not been included in the tables dealing with treatment plants or process details:

[15] 2,900.
[18] 890.
[20] 250.
[21] 325.
[22] 530.
[23] 2,115.
[24] 2,100.

The following populations served by supplies in other States are included in col. (4), but not in source and treatment detail:

[25] 5,500 from Rhode Island.
[26] 3,800 from Tennessee.
[27] 4,300 from Indiana.
[28] 755 from Ohio.
[29] 680 from Nebraska.
[30] 1,000 from West Virginia and 100 from Tennessee.
[31] 340 from Rhode Island.
[32] 200 from Maine.
[33] 32,865 from Connecticut.
[34] 1,070 from West Virginia and 1,590 from Pennsylvania.
[35] 330 from Kansas.
[36] 17,000 from Arkansas.
[37] 120,000 from District of Columbia.
[38] 5,100 from Kentucky and 2,710 from Maryland.

The following populations serve communities in other States, and are not included in col. (4), but are included in the details of source and treatment:

[39] 17,000 in Texas.
[40] 32,865 in New York.
[41] 120,000 in Virginia.
[42] 4,300 in Illinois.
[43] 330 in Oklahoma.
[44] 5,100 in West Virginia.
[45] 200 in New Hampshire.
[46] 2,710 in West Virginia.
[47] 680 in Iowa.
[48] 755 in Indiana.
[49] 1,590 in Ohio.
[50] 5,500 in Connecticut and 340 in Massachusetts.
[51] 3,800 in Georgia and 100 in Kentucky.
[52] 1,070 in Ohio and 1,000 in Kentucky.

Table 6. *Source of water supply for number of communities and population served—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Total		Ground sources		Surface sources		Both ground and surface sources	
	Number of communities	Estimated population served	Number of communities	Estimated population served	Number of communities	Estimated population served	Number of communities	Estimated population served
POPULATION GROUPS								
Less than 500	4,263	1,098,850	3,234	901,205	898	169,845	131	27,800
500–1,000	4,170	2,442,810	3,072	1,952,290	933	401,675	165	88,845
1,000–5,000	6,047	11,379,165	3,663	7,121,010	1,974	3,564,215	410	693,940
5,000–10,000	1,126	6,833,025	516	3,618,105	496	2,504,755	114	710,165
10,000–25,000	719	9,837,075	244	3,874,750	386	4,747,340	89	1,214,985
25,000–50,000	221	7,764,745	58	2,330,405	136	4,429,050	27	1,005,290
50,000–100,000	108	7,835,185	19	1,481,810	73	4,943,250	16	1,410,125
More than 100,000	93	46,264,280	14	2,993,455	67	30,305,885	12	12,964,940
STATES								
Alabama	314	1,547,035	201	550,760	109	985,275	4	11,000
Arizona	88	413,455	74	231,155	3	24,500	11	157,800
Arkansas	184	793,930	140	389,920	43	391,010	1	13,000
California	490	7,164,105	297	2,067,680	106	1,759,700	87	3,336,725
Colorado	207	802,345	100	103,690	96	676,505	11	22,240
Connecticut	196	1,724,655	36	40,035	140	1,571,290	20	113,330
Delaware	40	201,995	32	71,695	8	130,300	.....	.....
District of Columbia	1	892,000	.....	.....	1	892,000	.....	.....
Florida	339	1,673,190	316	1,310,335	16	55,650	7	307,205
Georgia	356	1,376,560	245	319,730	101	930,725	10	126,105
Idaho	174	312,510	121	196,595	38	72,930	15	42,985
Illinois	712	6,126,160	500	1,276,700	212	4,849,460	.....	.....
Indiana	366	2,124,950	300	726,045	45	720,705	21	678,200
Iowa	587	1,384,930	545	1,041,370	39	328,980	3	14,580
Kansas	384	1,037,945	319	577,835	58	444,010	7	16,160
Kentucky	301	1,173,325	130	171,550	160	973,375	11	28,400
Louisiana	221	1,459,475	184	587,775	36	870,900	1	800
Maine	193	602,570	49	49,025	131	501,145	13	52,400
Maryland	159	1,363,730	78	106,845	33	1,151,455	48	105,430
Massachusetts	263	4,221,835	108	583,755	104	3,159,210	51	478,870

Michigan	458	3,848,970	344	955,790	109	2,840,700	5	52,480
Minnesota	510	1,594,840	467	583,895	40	718,330	3	292,615
Mississippi	216	642,000	212	468,500	3	138,500	1	35,000
Missouri	355	2,242,715	224	302,225	127	1,869,580	4	70,910
Montana	115	305,270	68	68,415	38	190,955	9	45,900
Nebraska	410	704,250	401	459,980	9	244,270	.....	.....
Nevada	38	82,205	29	46,850	7	32,370	2	2,985
New Hampshire	118	347,675	39	99,105	72	242,145	7	6,425
New Jersey	451	3,930,935	261	999,325	101	2,118,045	89	813,565
New Mexico	97	335,560	77	276,920	20	58,640	.....	.....
New York	1,261	12,297,095	616	1,058,650	545	3,352,005	100	7,886,440
North Carolina	360	1,490,670	170	263,435	185	1,203,145	5	24,090
North Dakota	111	201,599	99	103,640	10	90,650	2	7,300
Ohio	621	5,061,770	390	1,423,660	219	3,560,600	12	77,510
Oklahoma	348	1,139,550	251	345,400	90	750,045	7	44,105
Oregon	340	945,030	143	151,825	171	704,765	26	88,440
Pennsylvania	1,613	8,042,645	507	755,180	892	5,597,645	214	1,689,820
Rhode Island	74	691,395	38	51,210	34	637,475	2	2,710
South Carolina	232	908,030	140	243,825	92	664,205	.....	.....
South Dakota	195	263,260	180	196,690	14	66,230	1	340
Tennessee	220	1,205,085	166	512,760	46	616,725	8	75,600
Texas	930	4,270,210	762	2,215,230	145	1,353,830	23	701,150
Utah	200	440,890	173	266,730	19	10,885	8	163,275
Vermont	156	206,755	89	44,630	33	101,395	34	60,730
Virginia	411	1,377,560	280	200,415	112	1,053,985	19	123,160
Washington	359	1,475,970	218	457,660	112	769,375	29	248,935
West Virginia	551	931,200	337	339,650	186	557,155	28	34,395
Wisconsin	352	1,925,775	321	899,265	29	987,770	2	38,740
Wyoming	70	149,535	43	79,765	24	45,470	3	24,300
GEOGRAPHICAL AREAS								
New England	1,000	7,794,885	359	867,760	514	6,212,660	127	714,465
Middle Atlantic	3,325	24,270,675	1,384	2,813,155	1,538	11,067,695	403	10,389,825
South Atlantic	2,449	10,214,935	1,598	2,855,930	734	6,638,620	117	720,385
East North Central	2,509	19,087,625	1,855	5,281,460	614	12,959,235	40	846,930
East South Central	1,051	4,567,445	709	1,703,570	318	2,713,875	24	150,000
West North Central	2,552	7,429,530	2,235	3,265,635	297	3,762,050	20	401,845
West South Central	1,683	7,663,165	1,337	3,538,325	314	3,365,785	32	759,055
Mountain	989	2,841,770	685	1,270,030	245	1,112,255	59	459,485
Pacific	1,189	9,585,105	658	2,677,165	389	3,233,840	142	3,674,100
Total	16,747	93,455,135	10,820	24,273,030	4,963	51,066,015	964	18,116,090

Table 7. *Treatment of water supply for number of communities and population served—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Total		Treated		Untreated		Both treated and untreated		Treatment, if any, unreported	
	Number of communities	Estimated population served	Number of communities	Estimated population served	Number of communities	Estimated population served	Number of communities	Estimated population served	Number of communities	Estimated population served
POPULATION GROUPS										
Less than 500	4,263	1,098,850	1,432	318,970	2,766	761,770	46	12,110	19	6,000
500–1,000	4,170	2,442,810	1,911	1,007,915	2,193	1,386,335	51	29,430	15	19,130
1,000–5,000	6,047	11,379,165	3,837	7,215,225	2,024	3,732,965	176	417,405	10	13,570
5,000–10,000	1,126	6,833,025	889	5,211,205	182	1,281,505	54	332,645	1	7,670
10,000–25,000	719	9,837,075	617	8,464,690	62	849,420	40	522,965	.....	.....
25,000–50,000	221	7,764,745	201	6,933,850	9	367,270	11	463,625	.....	.....
50,000–100,000	108	7,835,185	103	7,360,185	2	220,000	3	255,000	.....	.....
More than 100,000	93	46,264,280	88	37,891,325	1	95,000	4	8,277,955	.....	.....
STATES										
Alabama	314	1,547,035	248	1,424,405	66	122,630	.....	.....	6	11,690
Arizona	88	413,455	43	327,185	34	74,580	.....	.....	1	300
Arkansas	184	793,930	111	653,970	72	139,660	.....	.....	.....	.....
California	490	7,164,105	188	5,454,910	271	1,230,085	31	379,110	.....	.....
Colorado	207	802,345	69	681,870	134	115,665	1	2,290	3	2,520
Connecticut	196	1,724,655	164	1,696,260	23	16,450	9	11,945	.....	.....
Delaware	40	201,995	16	146,470	23	33,915	1	21,610	.....	.....
District of Columbia	1	892,000	1	892,000	.....	.....	.....	.....	.....	.....
Florida	339	1,673,190	145	1,262,135	193	221,755	1	189,300	.....	.....
Georgia	356	1,376,560	227	1,275,205	125	73,755	3	26,100	1	1,500
Idaho	174	312,510	44	127,690	123	130,120	7	54,700	.....	.....
Illinois	712	6,126,160	444	5,772,180	266	353,110	.....	.....	2	870
Indiana	366	2,124,950	256	1,970,965	101	123,495	9	30,490	.....	.....
Iowa	587	1,384,930	272	1,072,655	303	214,130	11	96,855	1	1,290
Kansas	384	1,037,945	188	915,670	191	109,575	5	12,700	.....	.....
Kentucky	301	1,173,325	239	1,132,310	58	35,665	4	5,350	.....	.....
Louisiana	221	1,459,475	95	1,209,920	122	217,205	4	32,350	.....	.....
Maine	193	602,570	147	565,765	43	29,005	3	7,800	.....	.....
Maryland	159	1,363,730	119	1,338,195	40	25,535	.....	.....	.....	.....
Massachusetts	263	4,221,835	142	3,687,250	88	287,025	32	247,280	1	280
Michigan	458	3,848,970	179	3,401,780	273	405,690	6	41,500	.....	.....
Minnesota	510	1,594,840	157	1,323,775	341	207,375	12	63,690	.....	.....
Mississippi	216	642,000	63	454,180	153	187,820	.....	.....	.....	.....
Missouri	355	2,242,715	221	2,121,490	134	121,225	.....	.....	.....	.....
Montana	115	305,270	46	223,510	65	70,960	4	10,800	.....	.....

Nebraska	410	704,250	31	385,640	378	312,400	1	6,210		
Nevada	38	82,205	9	36,520	28	43,200	1	2,485		
New Hampshire	118	347,675	53	283,420	63	62,815	2	1,440		
New Jersey	451	3,930,935	324	3,372,170	58	189,105	67	360,780	2	5,880
New Mexico	97	335,560	51	260,290	46	75,270				
New York	1,261	12,297,095	738	4,187,210	474	428,965	43	7,678,540	6	2,380
North Carolina	360	1,490,670	240	1,355,650	118	128,320	2	6,700		
North Dakota	111	201,590	18	114,690	92	85,600	1	1,300		
Ohio	621	5,061,770	452	4,698,685	163	217,620	5	145,365	1	100
Oklahoma	348	1,139,550	139	943,680	208	195,820	1	50		
Oregon	340	945,030	179	828,215	149	94,115	10	19,220	2	3,450
Pennsylvania	1,613	8,042,645	1,368	7,706,155	192	178,640	53	157,850		
Rhode Island	74	691,395	54	667,455	20	23,940				
South Carolina	232	908,030	130	771,725	101	117,265	1	19,040		
South Dakota	195	263,260	55	170,505	138	73,060	2	19,695		
Tennessee	220	1,205,085	166	1,149,045	48	46,020	6	10,020		
Texas	930	4,270,210	343	3,135,570	559	594,060	11	528,070	17	12,510
Utah	200	440,890	23	235,820	176	205,070	1			
Vermont	156	206,755	20	100,125	126	74,20	10	32,425		
Virginia	411	1,377,560	223	1,280,020	181	79,015	5	17,925	2	600
Washington	359	1,475,970	134	1,195,715	221	240,955	4	39,300		
West Virginia	551	931,200	361	844,330	180	76,490	10	15,380		
Wisconsin	352	1,925,775	112	1,442,360	236	468,545	4	14,870		
Wyoming	70	149,535	26	106,595	42	37,340	2	5,600		
GEOGRAPHICAL AREAS										
New England	1,000	7,794,885	580	7,000,275	363	493,440	56	300,890	1	280
Middle Atlantic	3,325	24,270,675	2,430	15,265,535	724	796,710	163	8,197,170	8	11,260
South Atlantic	2,449	10,214,935	1,462	9,165,730	961	756,050	23	291,055	3	2,100
East North Central	2,509	19,087,625	1,443	17,285,970	1,039	1,568,460	24	232,225	3	970
East South Central	1,051	4,567,445	716	4,159,940	325	392,135	10	15,370		
West North Central	2,552	7,429,530	942	6,104,425	1,577	1,123,365	32	200,450	1	1,290
West South Central	1,683	7,663,165	688	5,943,140	961	1,146,745	16	560,470	18	12,810
Mountain	989	2,841,770	316	1,999,480	648	752,205	16	75,855	9	14,210
Pacific	1,189	9,585,105	501	7,478,870	641	1,665,155	45	437,630	2	3,450
Total	16,747	93,455,135	9,078	78,403,365	7,239	8,694,265	385	10,311,135	45	43,570

Table 8. *Treatment of ground water supplies—by number of communities and estimated population served—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Number of communities					Estimated population served				
	Total	Treated	Untreated	Both treated and untreated	Treatment if any, unreported	Total	Treated	Untreated	Both treated and untreated	Treatment if any, unreported
POPULATION GROUPS										
Less than 500	3,234	659	2,532	26	17	901,205	196,225	696,090	4,490	4,400
500–1,000	3,072	974	2,056	28	14	1,952,290	628,905	1,290,235	16,680	16,470
1,000–5,000	3,663	1,641	1,920	93	9	7,121,010	3,302,775	3,540,735	266,220	11,280
5,000–10,000	516	319	176	29	1	3,618,105	2,200,235	1,248,125	162,075	7,670
10,000–25,000	244	166	61	17	.....	3,874,750	2,823,355	834,920	216,475	.....
25,000–50,000	58	46	9	3	.....	2,330,405	1,827,315	367,270	135,820	.....
50,000–100,000	19	16	2	1	.....	1,481,810	1,186,310	220,000	75,500	.....
More than 100,000	14	12	1	1	.....	2,993,455	2,789,800	95,000	108,655	.....
STATES										
Alabama	201	135	66	.....	.....	550,760	428,130	122,630	.....	.....
Arizona	74	35	33	.....	6	231,155	146,885	72,580	.....	11,690
Arkansas	140	68	72	.....	.....	389,920	250,260	139,660	.....	.....
California	297	38	256	3	.....	2,067,680	722,095	1,302,635	42,950	.....
Colorado	100	9	89	.....	2	103,600	23,110	79,270	.....	1,220
Connecticut	36	15	20	1	.....	40,035	24,365	14,975	695	.....
Delaware	32	8	23	1	.....	71,695	16,170	33,915	21,610	.....
District of Columbia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Florida	316	124	192	.....	.....	1,310,335	1,088,680	221,655	.....	.....
Georgia	245	119	125	.....	1	319,730	244,475	73,755	.....	1,500
Idaho	121	17	100	4	.....	196,595	34,610	114,535	47,450	.....
Illinois	500	232	266	.....	2	1,276,700	922,720	353,110	.....	870
Indiana	300	190	101	9	.....	726,045	572,060	123,495	30,490	.....
Iowa	545	230	303	11	1	1,041,370	729,095	214,130	96,855	1,290
Kansas	319	125	189	5	.....	577,835	457,360	107,775	12,700	.....
Kentucky	130	72	56	2	.....	171,550	132,710	34,640	4,200	.....
Louisiana	184	59	122	3	.....	587,775	339,020	217,205	31,550	.....
Maine	49	16	30	3	.....	49,025	24,500	16,725	7,800	.....
Maryland	78	40	38	.....	.....	106,845	82,030	24,815	.....	.....
Massachusetts	108	28	70	9	1	583,755	247,335	256,895	79,245	280

Michigan	344	68	271	5	.....	955,790	522,320	404,520	28,950	.....
Minnesota	467	120	335	12	.....	583,895	313,680	206,525	63,690	.....
Mississippi	212	59	153	.....	.....	468,500	280,680	187,820	.....	.....
Missouri	224	90	134	.....	.....	302,225	181,000	121,225	.....	.....
Montana	68	11	55	2	.....	68,415	7,815	58,500	2,100	.....
Nebraska	401	22	378	1	.....	459,980	141,370	312,400	6,210	.....
Nevada	29	4	25	.....	.....	46,850	5,500	41,350	.....	.....
New Hampshire	39	10	28	1	.....	99,105	73,150	25,315	640	.....
New Jersey	261	156	58	45	2	999,325	646,775	189,105	154,565	8,880
New Mexico	77	31	46	.....	.....	276,920	201,650	75,270	.....	.....
New York	616	174	406	30	6	1,058,650	577,030	383,880	95,360	2,380
North Carolina	170	50	118	2	.....	263,435	128,415	128,320	6,700	.....
North Dakota	99	7	92	.....	.....	103,640	18,040	85,600	.....	.....
Ohio	390	221	163	5	1	1,423,660	1,060,575	217,620	145,365	100
Oklahoma	251	47	204	.....	.....	345,400	151,400	194,000	.....	.....
Oregon	143	36	103	3	1	151,825	74,760	75,035	1,240	790
Pennsylvania	507	334	157	16	.....	755,180	595,335	137,800	22,045	.....
Rhode Island	38	18	20	.....	.....	51,210	27,270	23,940	.....	.....
South Carolina	140	38	101	1	.....	243,825	107,520	117,265	19,040	.....
South Dakota	180	43	135	2	.....	196,690	104,695	72,395	19,695	.....
Tennessee	*166*	*112*	*48*	*6*	.....	*512,760*	*456,720*	*46,020*	*10,020*	.....
Texas	762	201	544	1	16	2,215,230	1,620,455	572,555	12,000	10,220
Utah	173	13	159	1	.....	266,730	75,605	191,125	.....	.....
Vermont	89	5	83	1	.....	44,630	11,115	32,790	725	.....
Virginia	280	101	176	1	2	200,415	122,135	76,930	750	600
Washington	218	33	183	2	.....	457,660	237,150	218,435	2,075	.....
West Virginia	337	168	163	6	.....	339,650	264,710	70,610	4,330	.....
Wisconsin	321	82	235	4	.....	899,265	416,780	467,615	14,870	.....
Wyoming	43	10	33	.....	.....	79,765	45,755	34,010	.....	.....
GEOGRAPHICAL AREAS[a]										
New England	359	92	251	15	1	867,760	407,735	370,640	89,185	280
Middle Atlantic	1,384	664	621	91	8	2,813,155	1,819,140	716,785	271,970	11,260
South Atlantic	1,598	648	936	11	3	2,855,930	2,054,135	747,265	52,430	2,100
East North Central	1,855	793	1,036	23	3	5,281,460	3,494,455	1,566,360	219,675	970
East South Central	709	378	323	8	.....	1,703,570	1,298,240	391,110	14,220	.....
West North Central	2,235	637	1,566	31	1	3,265,635	1,945,145	1,120,050	199,150	1,290
West South Central	1,337	375	942	4	16	3,538,395	2,361,135	1,123,420	43,550	10,220
Mountain	685	130	540	7	8	1,270,640	540,930	666,640	49,550	12,910
Pacific	658	107	542	8	1	2,677,165	1,034,605	1,596,105	46,265	790
Total	10,820	3,824	6,757	198	41	24,273,310	14,954,920	8,292,375	985,915	39,820

Table 9. *Treatment of surface water supplies—by number of communities and estimated population served—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Number of communities					Estimated population served				
	Total	Treated	Untreated	Both treated and untreated	Treatment, if any, unreported	Total	Treated	Untreated	Both treated and untreated	Treatment, if any, unreported
POPULATION GROUPS										
Less than 500	898	700	192	4	2	169,845	112,005	55,295	945	1,600
500–1,000	931	829	99	4	1	401,675	323,075	69,935	6,005	2,660
1,000–5,000	1,974	1,892	71	10	1	3,564,215	3,412,095	130,945	19,785	2,290
5,000–10,000	496	491	5			2,504,755	2,475,375	29,380		
10,000–25,000	386	385		1		4,747,340	4,736,140		11,200	
25,000–50,000	136	135		1		4,429,050	4,379,450		49,600	
50,000–100,000	73	73				4,943,250	4,943,250			
More than 100,000	67	67				30,305,885	30,305,885			
STATES										
Alabama	109	109				985,275	985,275			
Arizona	3	3				24,500	24,500			300
Arkansas	43	42			1	391,010	390,710			
California	106	96	9	1		1,759,700	1,738,850	18,350	2,500	
Colorado	96	52	42	1	1	676,505	639,810	33,105	2,290	1,300
Connecticut	140	137	2	1		1,571,290	1,570,015	275	1,000	
Delaware	8	8				130,300	130,300			
District of Columbia	1	1				892,000	892,000			
Florida	16	16				55,650	55,650			
Georgia	101	101				930,725	930,725			
Idaho	38	21	15	2		72,940	55,660	11,470	5,800	
Illinois	212	212				4,849,460	4,849,460			
Indiana	45	45				720,705	720,705			
Iowa	39	39				328,980	328,980			
Kansas	58	58				444,010	444,010			
Kentucky	160	158	2			973,375	972,350	1,025		
Louisiana	36	36				870,900	870,900			
Maine	131	119	12			501,145	489,865	11,280		
Maryland	33	31	2			1,151,455	1,150,735	720		
Massachusetts	104	87	13	4		3,159,210	3,069,580	23,170	66,060	

Michigan	109	107	2			2,840,700	2,839,530	1,170			
Minnesota	40	34	6			718,330	717,480	850			
Mississippi	3	3				138,500	138,500				
Missouri	127	127				1,869,580	1,869,580				
Montana	38	30	8			190,955	179,855	11,100			
Nebraska	9	9				244,270	244,270				
Nevada	7	4	3			32,370	30,520	1,850			
New Hampshire	72	39	32	1		242,145	206,820	34,525	800		
New Jersey	101	101				2,118,045	2,118,045				
New Mexico	20	20				58,640	58,640				
New York	545	494	49	2		3,352,605	3,320,565	30,845	605		
North Carolina	185	185				1,203,145	1,203,145				
North Dakota	10	10				90,650	90,650				
Ohio	219	219				3,560,600	3,560,600				
Oklahoma	90	85	4	1		750,045	748,175	1,820	50		
Oregon	171	129	40	1	1	704,765	687,245	14,145	715	2,660	
Pennsylvania	892	865	26	1		5,597,645	5,563,365	33,990	290		
Rhode Island	34	34				637,475	637,475				
South Carolina	92	92				664,205	664,205				
South Dakota	14	12	2			66,240	65,905	325			
Tennessee	46	46				616,725	616,725				
Texas	145	130	12	2	1	1,353,830	1,341,995	6,145	3,400	2,290	
Utah	19	6	13			10,885	5,215	5,670			
Vermont	33	10	22	1		101,395	77,425	21,545	2,425		
Virginia	112	108	3	1		1,053,985	1,052,650	1,335			
Washington	112	85	27			769,375	756,810	12,565			
West Virginia	186	175	11			557,155	554,025	3,130			
Wisconsin	29	28	1			987,770	986,840	930			
Wyoming	24	14	9	1		45,470	40,540	3,330	1,600		
GEOGRAPHICAL AREAS											
New England	514	426	81	7		6,212,660	6,051,580	90,795	70,285		
Middle Atlantic	1,538	1,469	75	3		11,067,695	11,001,975	64,825	895		
South Atlantic	734	717	16	1		6,638,620	6,633,435	5,185			
East North Central	644	644	3			12,959,245	12,957,135	2,100			
East South Central	318	316	2			2,713,875	2,712,850	1,025			
West North Central	297	289	8			3,762,050	3,760,875	1,175			
West South Central	344	293	16	3	2	3,365,785	3,351,780	7,965	3,450	2,590	
Mountain	245	150	90	4	1	1,112,255	1,034,740	66,525	9,690	1,300	
Pacific	389	310	76	2	1	3,233,840	3,182,905	45,060	3,215	2,660	
Total	4,963	4,572	367	20	4	51,066,015	50,687,275	284,655	87,535	6,550	

Table 10. *Treatment of supply for number of communities and estimated population served by both ground and surface sources—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Number of communities				Estimated population served			
	Total	Treated	Untreated[1]	Both treated and untreated	Total	Treated	Untreated	Both treated and untreated
POPULATION GROUPS								
Less than 500	131	73	42	16	27,800	10,740	10,385	6,675
500–1,000	165	108	38	19	88,845	55,935	26,165	6,745
1,000–5,000	410	304	33	73	693,940	500,355	62,185	131,400
5,000–10,000	114	88	1	25	710,165	535,595	4,000	170,570
10,000–25,000	89	66	1	22	1,214,985	905,195	14,500	295,290
25,000–50,000	27	20		7	1,005,290	727,085		278,205
50,000–100,000	16	14		2	1,410,125	1,230,625		179,500
More than 100,000	12	9		3	12,964,940	4,795,640		8,169,300
STATES								
Alabama	4	4			11,000	11,000		
Arizona	11	10	1		157,800	155,800	2,000	
Arkansas	1	1			13,000	13,000		
California	87	54	6	27	3,336,725	2,993,965	9,100	333,660
Colorado	11	8	3		22,240	18,950	3,290	
Connecticut	20	12	1	7	113,330	101,880	1,200	10,250
Delaware								
District of Columbia								
Florida	7	5	1	1	307,205	117,805	100	189,300
Georgia	10	7		3	126,105	100,005		26,100
Idaho	15	6	8	1	42,985	37,420	4,115	1,450
Illinois								
Indiana	21	21			678,200	678,200		
Iowa	3	3			14,580	14,580		
Kansas	7	5	2		16,100	14,300	1,800	
Kentucky	11	9		2	28,400	27,250		1,150
Louisiana	1			1	800			800
Maine	13	12	1		52,400	51,400	1,000	
Maryland	48	48			105,430	105,430		
Massachusetts	51	27	5	19	478,870	369,935	6,960	101,975

Michigan	5	4		1	52,480	39,930		12,550
Minnesota	3	3			292,615	292,615		
Mississippi	1	1			35,000	35,000		
Missouri	4	4			70,910	70,910		
Montana	9	5	2	2	45,900	35,840	1,360	8,700
Nebraska								
Nevada	2	1		1	2,985	500	2,975	2,485
New Hampshire	7	4	3		6,425	3,450		
New Jersey	89	67		22	813,565	607,350		206,215
New Mexico								
New York	100	70	19	11	7,886,440	289,615	14,250	7,582,575
North Carolina	5	5			24,090	24,090		
North Dakota	2	1		1	7,300	6,000		1,300
Ohio	12	12			77,510	77,510		
Oklahoma	7	7			44,105	44,105		
Oregon	26	14	6	6	88,440	66,240	4,935	17,265
Pennsylvania	214	169	9	36	1,689,820	1,547,455	6,850	135,515
Rhode Island	2	2			2,710	2,710		
South Carolina								
South Dakota	1		1		340		340	
Tennessee	8	8			75,600	75,600		
Texas	23	12	3	8	701,150	173,120	15,360	512,670
Utah	8	4	4		163,275	155,000	8,275	
Vermont	34	5	21	8	60,730	11,585	19,870	29,275
Virginia	19	14	2	3	123,160	105,235	750	17,175
Washington	29	16	11	2	248,935	201,755	9,955	37,225
West Virginia	28	18	6	4	34,395	25,595	2,750	6,050
Wisconsin	2	2			38,740	38,740		
Wyoming	3	2		1	24,300	20,300		4,000
GEOGRAPHICAL AREAS								
New England	127	62	31	34	714,465	540,960	32,005	141,500
Middle Atlantic	403	306	28	69	10,389,825	2,444,420	21,100	7,924,305
South Atlantic	117	97	9	11	720,385	478,160	3,600	238,625
East North Central	40	39		1	846,930	834,380		12,550
East South Central	24	22		2	150,000	148,850		1,150
West North Central	20	16	3	1	401,845	398,405	2,140	1,300
West South Central	32	20	3	9	759,055	230,225	15,360	513,470
Mountain	59	36	18	5	459,485	423,810	19,040	16,635
Pacific	142	84	23	35	3,674,100	3,261,960	23,990	388,150
Total	964	682	125	167	18,116,090	8,761,170	117,235	9,237,685

Table 11.—*Number of plants and population served by various functional classes of treatment—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Total		Purification (rapid sand filtration)		Purification (slow sand filtration)		Combined purification and softening		Combined purification and iron and manganese removal		Combined purification softening and iron and manganese removal		Softening		Iron and manganese removal		Combined softening and iron and manganese removal	
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served
POPULATION GROUPS																		
Less than 500	859	325,325	100	48,645	8	1,895	9	3,045	4	1,000			23	8,990	87	31,080	13	4,930
500–1,000	1,396	1,026,005	209	172,350	10	6,540	19	12,550	4	3,010	1	400	84	63,300	153	105,035	68	41,385
1,000–5,000	2,952	7,422,675	773	2,577,635	25	58,720	71	177,705	6	10,905	4	4,580	157	345,370	252	526,410	116	210,075
5,000–10,000	747	5,380,765	256	2,010,570	5	27,350	27	188,100	2	15,000			44	299,605	32	190,445	27	169,995
10,000–25,000	552	8,762,305	210	3,501,560	18	263,180	30	396,900			2	41,560	27	491,080	38	658,655	11	183,070
25,000–50,000	193	7,210,005	86	3,260,270	3	87,950	11	397,460	1	167,200	3	402,770	5	148,500	7	283,450	3	103,000
50,000–100,000	102	7,523,435	50	4,017,750			6	356,800			2	134,500	2	136,750	1	79,600		
More than 100,000	185	45,602,655	69	18,288,320	15	1,569,000	15	3,391,935					3	1,953,000	8	657,200		
STATES																		
Alabama	194	1,424,405	70	1,009,015	1	3,000			1	1,000			1	500	11	36,835	1	600
Arizona	45	331,385	5	31,750	1	750	1	30,000					3	11,800				
Arkansas	104	653,970	35	411,810					1	1,000			1	2,700	36	105,420	3	16,200
California	162	5,642,290	37	1,585,330			3	78,600					7	81,130	4	29,340	2	20,700
Colorado	66	683,170	27	420,355	4	82,390												
Connecticut	94	1,669,190	22	361,500	5	297,750												
Delaware	12	150,080	3	88,800											6	53,920		
District of Columbia	2	892,000	1	446,000	1	446,000												
Florida	146	1,435,165	14	148,580			7	243,300					27	429,660	10	25,100	4	29,850
Georgia	199	1,282,755	75	929,370					4	16,790			3	13,600	2	910		
Idaho	52	156,790	6	36,400														
Illinois	336	5,768,980	97	679,185			5	39,075			11	283,350	9	19,710	44	98,795	73	165,250
Indiana	253	1,984,945	44	908,800	1	86,800	1	123,000					5	12,500	20	129,265	15	47,080
Iowa	277	1,120,445	29	218,660			6	122,460					49	109,555	86	290,930	19	16,910
Kansas	191	931,320	45	281,210			15	180,200					16	244,000	13	20,320	2	10,550
Kentucky	190	1,134,360	106	980,720			3	5,530	1	200			15	46,945	9	15,900	2	750
Louisiana	83	1,210,450	10	198,200			19	677,300					1	300	10	66,850	14	55,200
Maine	102	572,465	16	117,575	4	21,600									2	9,500		
Maryland	69	1,340,095	16	1,221,675									1	1,060	8	11,430		
Massachusetts	137	3,855,095	11	418,420	16	277,240							1	1,300	12	174,275		

Michigan	139	3,413,065	33	2,374,680			10	330,995					6	111,595	14	86,640	6	48,550
Minnesota	148	1,351,585	12	588,110			7	308,980					10	542,445	46	108,575	10	7,600
Mississippi	63	454,180	4	173,500									1	15,000	15	53,970	1	700
Missouri	152	2,121,490	57	805,290			14	1,132,610	1	720	1	400	20	32,850	12	21,440	19	44,310
Montana	99	228,940	8	72,180			2	10,630					1	835				
Nebraska	30	398,245	7	240,070									2	2,250	14	116,070	4	11,450
Nevada	11	37,760	3	28,020			1	2,500	2	500					1	13,000		
New Hampshire	99	284,460	5	15,100	3	13,800			2	3,800			2	15,800	26	195,295		
New Jersey	222	3,619,350	35	1,821,650	2	3,700							1	9,000				
New Mexico	39	260,290	4	17,290														
New York	478	11,343,480	105	2,039,935	29	345,795			2	4,335			15	39,780	12	252,975		
North Carolina	188	1,356,900	105	1,084,565	1	40							4	14,400	15	18,765	2	15,900
North Dakota	19	115,490	8	33,950			5	75,500					2	2,390	1	1,500	1	800
Ohio	317	5,770,655	58	2,820,860			39	734,650					84	426,960	29	53,165	18	55,510
Oklahoma	132	943,530	70	570,595			3	208,430					2	15,180	1	3,350		
Oregon	138	839,005	18	92,895									1	2,800				
Pennsylvania	650	7,772,665	152	4,429,290	9	348,175	17	360,960	2	167,720			13	153,460	6	9,280	3	58,000
Rhode Island	27	667,750	9	579,475									2	8,200	4	22,060	3	5,200
South Carolina	99	790,725	58	562,905			7	42,325					2	4,395	8	52,815	1	1,620
South Dakota	57	183,650	4	22,980											16	301,910	1	500
Tennessee	151	1,154,190	47	678,420			1	2,500					8	26,700	14	41,090	3	5,900
Texas	347	3,609,605	86	1,680,485	1	2,660	7	136,500										
Utah	21	235,820	2	1,450														
Vermont	24	120,000	3	31,300	1	7,435							8	8,120	5	3,415	2	3,500
Virginia	198	1,297,995	66	1,021,375	1	24,000	4	12,900										
Washington	124	1,212,425	14	93,925			9	55,400	1	1,050			19	21,825	46	53,150	11	54,575
West Virginia	273	848,890	89	513,240			1	10,650					8	15,850	20	54,650	14	35,250
Wisconsin	99	1,447,210	16	958,510	2	40,500	1	2,500					1	2,000				
Wyoming	28	109,395	6	32,100	2	13,000												
GEOGRAPHICAL AREAS																		
New England	433	7,168,960	66	1,523,370	29	617,825			2	3,800			1	1,300	15	196,775		
Middle Atlantic	1,350	22,735,395	292	8,296,875	40	697,670	17	360,960	4	172,055			30	209,040	44	477,550	3	58,000
South Atlantic	1,186	9,390,605	427	6,016,110	3	470,040	20	311,600	5	17,840			64	496,865	96	188,750	22	109,025
East North Central	1,144	17,383,955	248	7,742,035	3	127,300	56	1,238,370			11	283,350	112	586,615	127	427,485	126	351,640
East South Central	598	4,167,135	227	2,841,655	1	3,000	4	8,030	2	1,200			17	62,445	51	408,615	5	2,550
West North Central	874	6,222,225	162	2,190,270			54	1,862,075	1	720	1	400	95	937,885	180	606,650	56	93,240
West South Central	666	6,447,555	201	2,861,090	1	2,660	29	1,022,230	1	1,000			12	44,880	61	116,710	20	77,300
Mountain	311	2,043,520	61	639,545	7	96,140	5	45,630	2	500			6	23,63[illegible]				
Pacific	424	7,693,720	69	1,772,150			3	78,600					8	83,930	4	29,340	2	20,700
Total	6,986	83,253,170	1,753	33,877,100	84	2,014,635	188	4,927,495	17	197,115	12	283,750	345	2,446,595	578	2,531,875	234	712,455

Table 11. *Number of plants and population served by various functional classes of treatment—arranged by population groups, States, and geographical areas*—Continued

Population groups, States, and geographical areas	Disinfection only, or with miscellaneous treatment									Miscellaneous						
	Total number of plants	Estimated population served	None	Aeration	Corrosion control	Sedimentation	Coagulation, sedimentation	Ammonia	Other	Total number of plants	Estimated population served	Aeration	Corrosion control	Sedimentation	Coagulation, sedimentation	Other
			Number of plants	Number of plants	Number of plants	Number of plants	Number of plants	Number of plants	Number of plants			Number of plants	Number of plants	Number of plants	Number of plants	Number of plants
POPULATION GROUPS																
Less than 500	590	217,720	558	7	10	2	4	1	8	25	8,020	3	11	2	1	8
500–1,000	805	592,595	729	15	17	11	11	3	19	43	28,840	19	13	1		10
1,000–5,000	1,461	3,290,235	1,254	54	37	14	17	53	32	87	221,040	31	34	2	3	17
5,000–10,000	343	2,396,380	260	20	23	1	5	27	7	15	83,320	2	11	1		1
10,000–25,000	205	3,082,280	149	11	10	4	4	19	8	11	144,080	2	6			3
25,000–50,000	73	2,651,155	53	1	2	2		13	2	1	8,250		1			
50,000–100,000	41	2,798,035	28		4		3	5	1							
More than 100,000	68	21,085,100	38	1	8	1	1	19		7	170,100		1			6
STATES																
Alabama	103	351,055	87	6	5				5	6	22,400	4	2			
Arizona	34	252,585	31					3		1	4,500		1			
Arkansas	28	116,840	22	1	2	1	1		1					•		
California	103	3,835,740	73	8	1	6	6	9		6	11,450	5				
Colorado	34	180,125	28			2	2		2	1	300		1			1
Connecticut	64	1,003,240	51		10	1		2		3	6,700		2			
Delaware										3	7,360	3			1	
District of Columbia																
Florida	66	393,425	41	16	1				8	18	165,650	4				14
Georgia	107	317,425	94	1	3			2	7	8	4,660	1	1			6
Idaho	46	120,390	44			1		1								
Illinois	96	4,483,165	93		2			1		1	450	1				
Indiana	167	676,600	157	3	4			1	2							
Iowa	88	361,930	37		1											
Kansas	101	192,420	88		8				5	5	2,620	2	3			
Kentucky	52	76,515	41	5		5			1	2	7,800	1		1		
Louisiana	28	242,950	20	5	1			1	1	1	550					
Maine	79	422,975	67		1			10	1	1	815		1			1
Maryland	44	105,930	38	1	1			1	3							
Massachusetts	78	2,915,460	58		12			7	1	19	68,400		19			

Michigan	70	460,635	70					2		22	62,940		22			
Minnesota	41	247,935	30	1	8			2	4	7	8,600	3				4
Mississippi	35	202,410	24	5					3	3	1,570	3				
Missouri	25	82,300	17	4	1											
Montana	38	145,265	27			3		8								
Nebraska	3	28,405	2		1											
Nevada	5	6,740	5													
New Hampshire	35	230,260	34		1					3	8,500		3			
New Jersey	149	1,542,445	122	8	7			9	3	8	40,460	6	1			1
New Mexico	30	217,900	21			6	1		2	4	16,100		1	3		
New York	306	8,536,950	250	6	16		1	30	3	9	123,710		5			4
North Carolina	56	214,355	44	2	3		1	5	1	5	8,875	1	2			2
North Dakota	1	650				1				1	700					1
Ohio	81	674,450	79						2	8	5,050	3				5
Oklahoma	54	144,365	48		1	3	2			2	1,610	1				1
Oregon	119	743,310	103		2		1	13								
Pennsylvania	443	2,239,305	416	9	6	1		8	3	5	6,475	1	2		1	1
Rhode Island	18	88,275	12		3	2			1							
South Carolina	20	148,215	15	1	4					12	44,145	1	9			2
South Dakota	34	58,015	31	1				1	1	1	1,500					1
Tennessee	84	168,530	70	3	1			1	9	2	2,330	2				
Texas	214	1,699,490	156	19	1	1	29	2	6	14	16,780	11		1	2	
Utah	18	233,070	11				1	6		1	1,300	1				
Vermont	20	81,265	20													
Virginia	110	218,095	106	1		1			2	2	2,590		2			
Washington	108	1,114,000	94					14		2	4,500	1				1
West Virginia	96	148,900	90	2	3	1				2	750	2				
Wisconsin	38	331,800	35	1	1			1								
Wyoming	17	58,295	17							1	1,500			1		
GEOGRAPHICAL AREAS																
New England	294	4,741,475	242		27	3		19	3	26	84,415		25		1	
Middle Atlantic	898	12,318,700	788	23	29	1	1	47	9	22	170,645	7	8		1	6
South Atlantic	499	1,546,345	428	24	15	2	1	8	21	50	234,030	12	14			24
East North Central	452	6,626,650	434	4	7			3	4	9	5,510	4				5
East South Central	274	798,510	222	19	6	5		3	19	17	41,130	10	2	1		4
West North Central	293	971,655	255	6	19	1		3	9	32	69,330	5	25			2
West South Central	324	2,202,745	246	25	5	5	32	3	8	17	18,940	12		1	2	2
Mountain	222	1,214,370	184			12	4	18	4	8	23,700	1	3	4		
Pacific	330	5,693,050	270	8	3	6	7	36		8	15,950	6				2
Total	3,586	36,113,500	3,069	109	111	35	45	140	77	189	663,650	57	77	6	4	45

[1] 515,000 included in this column not included in total column.

Table 12. *Number of plants and population served by various types of disinfection—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Total		Disinfection with—									
			Liquid chlorine		Hypochlorite		Chlorine—ammonia		Unreported method		Both liquid chlorine and hypochlorite	
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served
POPULATION GROUPS												
Less than 500	738	283,975	237	106,455	469	161,055	4	1,670	26	14,475	2	320
500–1,000	1,148	865,155	519	427,970	554	377,755	31	28,810	37	23,620	6	5,800
1,000–5,000	2,576	6,659,575	1,775	4,583,990	489	781,120	200	1,038,125	94	195,195	18	61,145
5,000–10,000	695	5,078,960	508	3,736,325	29	118,875	122	972,770	30	183,290	6	37,700
10,000–25,000	515	8,302,815	331	5,341,375	14	188,560	151	2,520,780	18	237,920	1	14,180
25,000–50,000	188	7,036,855	102	3,665,155	1	1,310	75	3,035,390	6	122,100	4	212,900
50,000–100,000	102	7,523,435	51	3,664,075			42	3,395,110	8	348,250		
More than 100,000	175	44,882,155	90	19,738,375	1	8,600	77	22,536,780	7	2,598,490		
STATES												
Alabama	187	1,398,545	87	1,279,895	99	106,650	1	12,000				
Arizona	44	326,885	20	126,010	19	36,075	4	164,000	1	800		
Arkansas	80	613,300	60	329,210	14	15,940	5	266,950	1	1,200		
California	150	5,608,540	41	1,068,660	6	18,230	25	1,581,555	78	2,940,095		
Colorado	56	567,645	44	550,660	9	6,525			3	10,460		
Connecticut	88	1,649,240	56	1,443,430	26	38,460	6	196,150				
Delaware	6	141,270	6	141,270								
District of Columbia	2	892,000					2	892,000				
Florida	130	1,373,790	75	740,910	25	19,725	22	606,955	8	6,200		
Georgia	189	1,277,185	127	494,775	42	27,960	19	754,000	1	450		
Idaho	52	156,790	29	98,750	18	10,640	5	47,400				
Illinois	252	5,681,940	174	1,239,135	39	37,665	37	4,403,400	2	1,740		
Indiana	248	1,977,645	164	1,041,695	61	37,345	21	892,150	2	6,455		
Iowa	183	1,022,465	90	689,435	78	70,645	8	198,080	7	64,305		
Kansas	181	897,950	78	283,410	75	52,440	24	554,800	3	6,800	1	500
Kentucky	182	1,118,540	121	297,690	24	17,155	23	789,500	14	14,195		
Louisiana	79	1,237,400	50	414,750	22	25,450	7	797,200				
Maine	101	571,650	47	205,100	32	47,250	21	318,600			1	700
Maryland	63	1,336,595	24	1,195,550	30	36,890	5	95,680	1	990	3	7,485
Massachusetts	90	3,475,435	57	1,173,410	13	30,120	16	2,248,790	4	23,115		

Michigan	121	3,340,080	75	1,092,875	28	40,245	16	2,033,460	2	173,500		
Minnesota	71	1,185,985	37	455,220	14	10,670	20	720,095				
Mississippi	54	438,580	26	248,110	21	24,470	4	162,500	3	3,500		
Missouri	129	2,094,580	104	833,550	7	7,480	16	1,241,450	2	2,100		
Montana	48	228,075	24	54,965	9	6,825	14	146,285	1	20,000		
Nebraska	16	362,715	7	22,940	2	4,190	3	311,580	4	24,005		
Nevada	11	37,760	6	9,240	2	500	2	25,000	1	3,020		
New Hampshire	39	256,660	18	205,250	21	51,410						
New Jersey	193	3,294,045	72	665,420	52	108,360	36	2,211,860	28	160,605	5	147,800
New Mexico	35	244,190	21	228,265	14	15,925						
New York	[1] 453	[1] 11,119,455	228	8,811,485	109	167,170	85	1,944,515	26	68,535	4	11,750
North Carolina	173	1,325,455	116	758,270	26	24,420	31	542,765				
North Dakota	16	112,790	9	27,590			7	85,200				
Ohio	211	4,554,380	131	2,322,140	56	61,195	22	2,167,910	1	2,355	1	780
Oklahoma	129	941,320	88	610,570	25	21,830	16	308,920				
Oregon	138	839,005	68	159,310	50	31,640	19	646,655			1	1,400
Pennsylvania	638	7,748,970	372	5,801,715	135	171,765	49	1,515,070	20	149,360	12	111,060
Rhode Island	25	667,455	7	584,925	15	24,030	3	58,500				
South Carolina	81	739,320	66	403,515	5	6,155	9	329,500	1	150		
South Dakota	52	177,640	32	132,060	12	5,485	8	40,095				
Tennessee	[2] 141	[2] 862,720	103	306,940	25	13,685	12	540,895				
Texas	318	3,577,020	243	2,678,945	61	62,600	12	833,050	2	2,425		
Utah	20	234,520	13	28,320			6	206,000	1	200		
Vermont	23	112,565	15	88,480	8	24,085						
Virginia	190	1,284,005	103	591,440	73	58,285	11	627,100	1	6,290	2	890
Washington	121	1,212,325	61	422,050	39	24,280	19	760,495			2	5,500
West Virginia	234	814,115	162	484,660	51	44,370	14	261,285	4	19,800	3	4,000
Wisconsin	68	1,395,340	40	384,530	15	11,340	13	959,290			2	40,180
Wyoming	26	107,045	16	55,995	2	9,700	4	30,750	4	10,600		
GEOGRAPHICAL AREAS												
New England	366	6,733,005	200	3,671,795	115	215,355	46	2,822,040	4	23,115	1	700
Middle Atlantic	1,284	22,162,470	672	15,278,620	346	447,295	170	5,671,445	74	378,500	21	270,610
South Atlantic	1,068	9,183,735	679	4,810,390	252	217,805	113	4,109,285	16	33,880	8	12,375
East North Central	900	16,949,385	584	6,080,375	197	187,790	109	10,456,210	7	184,050	3	40,960
East South Central	564	3,818,385	337	2,132,635	169	161,960	40	1,504,895	17	17,695		
West North Central	648	5,854,125	357	2,454,205	188	150,910	86	3,151,300	16	97,210	1	500
West South Central	606	6,369,040	441	4,033,475	122	125,820	40	2,206,120	3	3,625		
Mountain	292	1,902,910	173	1,152,205	73	86,190	35	619,435	11	45,080		
Pacific	409	7,659,870	170	1,650,020	95	74,150	63	2,988,705	78	2,940,095	3	6,900
Total	6,137	80,632,925	3,613	41,263,720	1,557	1,667,275	702	33,529,435	226	3,723,250	37	332,045

[1] 1 plant serving 116,000 having disinfection by other means is included in total.

[2] 1 plant serving 1,200 having disinfection by other means is included in total.

Table 13. *Number of plants and population served by selected unit processes—arranged by population groups, States, and geographical areas*

Population groups, States, and geographical areas	Filtration								Softening			
	Rapid sand—gravity		Slow sand		Rapid sand—pressure		Anthrafilt		Lime—soda		Zeolite	
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served
Population Groups												
Less than 500	100	52, 520	10	2, 595	107	33, 810	1	150	16	7, 240	29	9, 725
500–1,000	252	207, 060	13	8, 365	196	125, 730	1	550	75	52, 165	97	65, 470
1,000–5,000	939	2, 962, 405	36	76, 145	249	493, 820	19	66, 795	213	503, 435	135	234, 295
5,000–10,000	305	2, 387, 100	7	45, 380	30	205, 610	12	99, 270	74	533, 690	20	124, 010
10,000–25,000	269	4, 532, 975	27	445, 600	14	198, 495	12	281, 825	57	830, 300	13	282, 250
25,000–50,000	103	3, 848, 095	4	147, 750	7	270, 690	3	248, 470	19	651, 730	3	100, 000
50,000–100,000	58	4, 494, 700	1	107, 000	2	123, 700	2	185, 000	10	612, 050		
More than 100,000	80	20, 652, 855	19	2, 706, 200	11	942, 400	2	555, 000	17	4, 294, 435	1	53, 500
States												
Alabama	73	1, 035, 265			8	10, 385						
Arizona	[1] 6	61, 750	1	750							2	1, 100
Arkansas	[2] 49	467, 910			7	8, 800	1	33, 000	2	36, 000	2	5, 800
California	30	1, 421, 185	2	19, 000	17	321, 435			4	18, 900		
Colorado	21	414, 865	4	82, 390	5	4, 090			9	119, 100	3	61, 330
Connecticut	19	464, 000	5	297, 750	3	7, 650						
Delaware	2	84, 600	1	45, 700	4	8, 785						
District of Columbia	1	446, 000	1	446, 000								
Florida	40	762, 550			6	18, 875			31	648, 890	7	37, 920
Georgia	[3] 77	939, 200			[3] 13	357, 150	4	23, 860	2	12, 400	1	1, 200
Idaho	3	27, 500			2	6, 400						
Illinois	127	1, 115, 480			92	92, 275	5	49, 200	41	431, 585	57	75, 800
Indiana	50	[1] 70, 050	1	86, 800	18	28, 675	2	11, 820	6	149, 120	15	33, 460
Iowa	[4] 58	[2] 4, 940			88	74, 170	2	1, 430	26	204, 870	48	44, 055
Kansas	71	696, 380			3	5, 600			25	433, 200	2	1, 550
Kentucky	[5] 112	1, 024, 375	1	850	13	10, 270	[1] 1	400, 000	17	51, 675	3	1, 550
Louisiana	42	986, 100			7	6, 250			29	726, 700	5	6, 100
Maine	11	82, 700	5	48, 600	6	17, 375						
Maryland	[6] 13	1, 215, 835			10	17, 755					1	1, 060
Massachusetts	10	313, 320	26	545, 125							1	1, 300

Michigan	[7] 48	2,847,800			12	26,055	[7] 1	49,270	14	456,015	8	35,125
Minnesota	[8] 37	956,175			31	44,190			15	849,485	12	9,540
Mississippi	8	208,200			12	19,970	1	15,000	1	15,000	1	700
Missouri	[9] 88	1,992,580	1	350	15	9,980			34	1,181,950	20	28,220
Montana	[10] 10	82,810					[10] 1	32,000	2	10,630	1	835
Nebraska	20	351,620	1	1,850	4	6,100			4	11,150	2	2,550
Nevada	1	2,500			3	3,520			1	2,500		
New Hampshire	5	15,100	6	30,600								
New Jersey	[11 12 13] 26	895,775	3	3,810	[12 13 14] 25	427,660	[13 14] 3	166,400			2	15,800
New Mexico	3	15,490			2	10,800			1	9,000		
New York	[15] 79	1,850,345	[13] 34	432,450	36	437,545					15	39,780
North Carolina	103	1,105,350	2	1,740	17	17,180	1	4,500	3	25,900	3	4,400
North Dakota	16	113,340							7	77,890	1	800
Ohio	177	3,964,395			31	55,130	1	550	116	1,111,160	25	105,960
Oklahoma	[16] 70	775,565			2	3,910	2	7,480	5	223,610		
Oregon	[17 18] 12	63,360			[18] 7	34,615			1	2,800		
Pennsylvania	[19] 162	4,042,115	[19] 14	1,402,875	6	83,130	10	300,975	21	386,410	12	186,010
Rhode Island	7	576,200			1	1,500						
South Carolina	[20 21] 58	548,165			2	23,500	[21] 9	202,400			5	13,400
South Dakota	19	121,125			4	4,015			9	47,245	1	1,095
Tennessee	[22] 47	913,490			8	13,540	2	17,000	2	3,000		
Texas	[23 24] 73	1,789,420	3	7,460	21	87,090	1	1,800	14	159,740	4	9,360
Utah					2	1,450						
Vermont	3	31,300	1	7,435					1	12,900	10	11,620
Virginia	68	1,028,840	1	24,000	[25] 7	8,970						
Washington	11	56,660			1	6,750						
West Virginia	[26 27] 106	612,135			47	56,655	[27] 5	120,375	24	22,220	15	109,580
Wisconsin	28	1,040,250	2	40,500	16	12,060			9	39,500	14	22,250
Wyoming	6	33,600	2	13,000	2	3,000			2	4,500		
Geographical Areas												
New England	55	1,482,620	43	929,510	10	26,525					1	1,300
Middle Atlantic	267	6,788,235	51	1,839,135	67	948,335	13	467,375	21	386,410	29	241,590
South Atlantic	468	6,742,675	5	517,440	106	506,870	19	351,135	64	722,310	42	179,180
East North Central	430	10,097,975	3	127,300	169	214,195	9	110,840	186	2,187,380	119	272,595
East South Central	240	3,181,330	1	850	41	54,165	4	432,000	20	69,675	6	3,350
West North Central	309	4,646,160	2	2,200	145	144,055	2	1,430	120	2,805,790	86	87,810
West South Central	234	4,018,995	5	7,460	37	106,050	4	42,280	52	1,128,950	9	15,460
Mountain	50	638,515	7	96,140	16	29,260	1	32,000	8	62,630	3	6,635
Pacific	53	1,541,205	2	19,000	25	362,800			10	121,900	3	61,330
Total	2,106	39,137,710	117	3,539,035	616	2,394,255	52	1,437,060	487	7,485,045	298	869,250

See footnotes at end of table.

Table 13. *Number of plants and population served by selected unit processes—arranged by population groups, States, and geographical areas*—Continued

Population groups, States, and geographical areas	Aeration		Taste and odor control		Corrosion control		Laboratory control (at plant)		
	Number of plants	Estimated population served	Number of plants	Estimated population served	Number of plants	Estimated population served	Chemical	Bacteriological	Both
POPULATION GROUPS									
Less than 500	19	44,105	5	2,130	80	37,195	47	2	2
500–1,000	392	205,350	44	35,765	173	139,470	148	4	22
1,000–5,000	680	1,661,735	289	1,242,750	366	1,418,460	379	13	179
5,000–10,000	163	1,132,275	124	1,034,995	139	1,080,220	102	11	136
10,000–25,000	137	2,218,890	122	2,071,560	104	1,691,660	60	22	163
25,000–50,000	60	2,277,575	58	2,149,950	42	1,532,705	11	10	87
50,000–100,000	24	1,812,250	39	3,091,050	28	2,288,950	1	3	53
More than 100,000	33	8,331,840	36	8,940,595	48	9,946,535	3	8	90
STATES									
Alabama	29	70,630	2	22,800	64	990,135	75	1	3
Arizona			3	40,250	1	4,500	3	1	
Arkansas	48	205,020	13	285,800	4	174,500	5		5
California	34	811,920	12	135,935	10	1,026,450	2		4
Colorado	2	132,520			1	300			5
Connecticut	16	537,950	4	52,250	27	619,800	6	6	7
Delaware	6	13,010			1	6,390			
District of Columbia			2	892,000	2	892,000			2
Florida	88	814,290	17	384,500	20	132,085	17	1	16
Georgia	13	27,330	10	192,800	62	903,025	38		25
Idaho	1	4,000	3	27,500	1	10,500		1	2
Illinois	126	453,665	89	681,230	58	68,965	135		56
Indiana	50	355,140	25	952,650	12	28,400	18	6	31
Iowa	129	317,960	25	220,690	58	52,320	31		11
Kansas	59	459,650	41	397,900	31	273,940	27		11
Kentucky	40	255,000	35	777,000	12	444,400	36		9
Louisiana	27	128,750	8	185,500	4	12,200	29	4	7
Maine	3	39,500	6	62,700	12	126,690	1	2	1
Maryland	9	60,420	6	114,370	18	1,189,055	1		1
Massachusetts	24	705,555	6	252,340	44	619,320	10	1	5
Michigan	22	239,880	25	445,310	9	86,495		17	45
Minnesota	58	454,140	10	326,680	49	690,215	5		7
Mississippi	30	121,090			9	19,190	2		
Missouri	71	237,390	9	101,400	8	540,400	30		24
Montana			5	62,115	2	6,130	2		2
Nebraska	23	133,910	6	238,220	1	6,300	2		
Nevada	1	250	3	27,500	1	2,500			3
New Hampshire	3	16,800	3	8,600	2	17,740	1		
New Jersey	52	914,800	15	945,715	29	1,123,690			
New Mexico			1	9,000	3	28,270		1	

New York	70	4,734,175	71	1,249,455	71	1,084,950		13	76
North Carolina	27	145,140	35	548,165	87	1,008,415	15	1	85
North Dakota	4	54,300	4	76,600	3	13,200			
Ohio	92	367,240	30	2,787,595	49	929,265	73	6	95
Oklahoma	24	97,215			2	69,500	28		8
Oregon	2	8,000	10	48,625	2	4,900			
Pennsylvania	32	837,735	58	2,424,830	43	1,968,615	27	2	40
Rhode Island	4	520,550	4	183,550	11	234,285	3		1
South Carolina	11	126,660	21	277,135	27	565,925	8		28
South Dakota	12	79,325	3	25,070	3	21,535	3		1
Tennessee	36	546,415	14	264,620	25	378,050	22		23
Texas	106	1,597,525	27	978,055	3	449,100	15	3	39
Utah	1	1,300							
Vermont								1	
Virginia	17	395,255	13	454,850	33	945,600	7		15
Washington	1	2,000			4	53,815	6	4	3
West Virginia	74	434,245	28	439,970	40	283,445	53		23
Wisconsin	39	213,120	13	940,770	17	27,380	14	5	12
Wyoming	2	13,250	2	26,750			1		3
GEOGRAPHICAL AREAS									
New England	50	1,820,355	23	559,440	101	1,617,835	21	7	14
Middle Atlantic	154	6,486,710	144	4,620,000	143	4,177,255	27	15	116
South Atlantic	245	2,016,350	132	3,303,790	290	5,927,250	139	2	195
East North Central	329	1,629,045	182	5,807,555	145	1,140,505	240	34	239
East South Central	135	993,135	51	1,064,420	110	1,831,775	135	1	35
West North Central	356	1,736,675	98	1,386,560	153	1,597,910	98		54
West South Central	205	2,028,510	48	1,449,355	13	705,300	77	7	59
Mountain	7	151,320	17	193,145	9	52,200	6	3	13
Pacific	37	824,920	22	184,560	16	1,085,165	8	4	7
Total	1,518	17,684,020	717	18,568,795	980	18,135,195	751	73	732

[1] Includes 1 plant, type filter not reported.
[2] Includes 1 plant having coke filter.
[3] 1 plant serving 350,000 having both gravity and pressure filters listed in both columns.
[4] Includes 3 plants, type filter not reported.
[5] 1 plant serving 400,000 having both sand and anthrafilt filters listed in both columns.
[6] Includes 1 plant, type filter not reported.
[7] 1 plant serving 49,270 having both sand and anthrafilt filters listed in both columns.
[8] Includes 1 plant, type filter not reported.
[9] Includes 1 plant, type filter not reported.
[10] 1 plant serving 32,000 having both sand and anthrafilt filters listed in both columns.
[11] Includes 1 plant, type filter not reported.
[12] 1 plant serving 49,200 having both gravity and pressure filters listed in both columns.
[13] 1 plant serving 5,000 having pressure anthrafilt and gravity sand filters included in three columns.
[14] 1 plant serving 155,000 having pressure anthrafilt filters included in both columns.
[15] 1 plant serving 83,000 having both rapid and slow sand filters included in both columns.
[16] Includes 1 plant, type filter not reported.
[17] Includes 1 plant, type filter not reported.
[18] 1 plant serving 5,080, having both gravity and pressure filters listed in both columns.
[19] 3 plants serving 464,500, having both rapid and slow sand filters included in both columns.
[20] 6 plants serving 180,000, having both sand and anthrafilt filters listed in both columns.
[21] Includes 1 plant, type filter not reported.
[22] Includes 4 plants, type filter not reported.
[23] Includes 8 plants, type filter not reported.
[24] 2 plants having diatomite filters not shown in listings.
[25] Includes 2 plants, having pressure calcite filters.
[26] Includes 2 plants, one with excelsior filter, the other with excelsior and coke filter.
[27] 1 plant serving 85,000, having both sand and anthrafilt filters listed in both columns.

used in plants classified in categories not including "Purification" as a function. In a very few cases plants have been reported as purification plants, even though filters are not used.

Data concerning various methods of disinfection as a separate unit process are summarized in table 12. No attempt has been made to show what specific types of materials are used for chloramine disinfection, since an analysis of the number of possible combinations and their significance did not appear to be justified. Similarly, the point or points of application of the disinfectant in the various treatment processes are not summarized.

Detailed data concerning selected unit treatment processes are presented in table 13. This is separate and distinct from the "type of plant" data presented in table 11. For instance, the number of plants reported to use rapid sand filters in this table exceeds the number of plants reported as being of the rapid sand purification type in table 11. This is occasioned by the use of such filters in plants where the functional or design basis is not strictly "Purification" as defined in Inventory instructions. Information on type of laboratory, or the existence of one, has been omitted in a large percentage of Inventory entries; consequently, these data are incomplete.

II. ANALYSIS AND DISCUSSION

A. Water Supplies

General

In 1948, 16,747 communities in the United States were served by water supplies having a total connected population of almost 93.5 million persons. This was 64.3 percent of the total estimated population of the country in that year. The 1940 Census population of those communities served by supplies was exceeded about 5 percent by the connected population.

Almost 65 percent of the communities were served by ground sources, and 29.6 percent were served by surface supplies. The remainder received water from supplies using both ground and surface sources. Nationally, 54.2 percent of the communities received treated water and over 43 percent were served by untreated supplies. The balance received water from both treated and untreated supplies.

Considering population served, the largest percentage, 54.6 percent, received water from surface sources, and 79.6 percent of the total population served received treated water. Only 9.3 percent of the total population served received untreated water as the sole supply, but, as noted above, this was in over 43 percent of the communities served by public water supplies.

There were 6,986 water treatment plants serving more than 83,250,000 persons in the United States in 1948. Simple disinfection plants were the largest single type. Also, the largest population was served by this type of plant, which in some cases also included some miscellaneous process in addition to disinfection. This was closely followed by rapid sand purification plants which served 40.6 percent of the total population served by all types of treatment plants. A complete breakdown of National totals is given in table 2.

Disinfection was used in 6,137 plants serving over 80,600,000 persons. Liquid chlorine was used in the largest number of installations and served the greatest percentage of population.

Table 14 presents data by population groups on the number of communities included in the 1948 Inventory, together with the percentage of communities in each group having supplies. Approximately 74 percent of the 22,676 separate communities listed in the Inventory were served by water supplies, and substantially all communities of over 5,000 population were included. Only in communities of less than 1,000 population does the per-

centage fall below 90 percent. In this group, 60.5 percent of the communities listed were served by supplies.

States

The 1940 census population of communities having water supplies was exceeded by the estimated population served in a majority of the States. Nationwide, almost 105 percent of the census population of these communities was served by supplies. This anomalous situation is undoubtedly due to the comparison of data for two differing years. The percentage distribution by States has not been reproduced, since the data are of questionable value.

Table 14. *Total number of communities included in 1948 Inventory and percent served by water supplies—by population groups*

Population groups	Number of communities					Communities served by water supplies	Percent of total communities served by water supplies
	Incorporated [1]	Unincorporated [2]	Others [3]	Duplicated in Inventory listings [4]	Total		
Less than 1,000	9,665	1,962	2,405	90	13,942	8,433	60.5
1,000–5,000	4,627	1,447	499	133	6,440	6,047	93.9
5,000–10,000	965	122	69	13	1,143	1,126	98.5
10,000–25,000	665	54	15	5	729	719	98.6
25,000–50,000	213	9		1	221	221	100.0
50,000–100,000	107		1		108	108	100.0
More than 100,000	92		1		93	93	100.0
Total	16,334	3,594	2,990	242	22,676	16,747	73.9

[1] Includes all incorporated communities of over 100 population as listed in the *16th Census of the United States: 1940*. Population, Vol. 1, Number of Inhabitants. U. S. Government Printing Office, Washington, 1942.

[2] Includes unincorporated communities as listed in the *16th Census of the United States: 1940*. Population, Unincorporated Communities—Total population of unincorporated communities having 500 or more inhabitants for which separate figures could be compiled. U. S. Government Printing Office, Washington, 1943.

[3] Includes other places reported as separate entries in the 1948 Inventory by the various State health departments.

[4] Communities listed by Census Bureau, and duplicated under a larger civil division listing in the Inventory. Requires subtraction to obtain figure shown in "total" column.

[5] Of the 10 communities indicated as not having water supplies, 7 are unincorporated, and 3 are townships, portions of which are served by sewer systems but apparently not by water supplies.

Table 15 shows the percentage distribution by States of communities and population served arranged by source of supply and by treatment. These State data show wide variations in practice as regards both source and/or treatment. In Nebraska, 97.8 percent of the communities are served by ground supplies, and 92.2 percent of the communities received untreated water. This may be contrasted with Connecticut where 13.4 percent of the communities are served by ground sources, and only 11.7 percent of the communities receive untreated water.

Populationwise, in most States the majority receives water from surface sources, and in every State except Nevada and Idaho more people are served by treated supplies than by untreated ones. In New York, a considerable percentage of the population, 62.4 percent, is reported as being served by both treated and untreated supplies. This is due to the inclusion of New York City in this category, where a very small portion of the total supply is reported as being untreated. It might be noted in this connection, that of the 11.0 percent

of the total population in the country served by supplies which are both treated and untreated, about 90 percent receives treated water. This is based on the determination of persons served by treatment plants as shown later in this report. In New Mexico, 82.5 percent of the population is served by ground sources, as contrasted with Connecticut where only 2.3 percent of the

Table 15. *Percent of communities and population served by source of supply and treatment—arranged by States*

State	Percent of total communities served by—			Percent of total communities served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment if any, not reported
Alabama	64.0	34.7	1.3	79.0	21.0		
Arizona	84.1	3.4	12.5	54.6	38.6		6.8
Arkansas	76.1	23.4	.5	60.3	39.1		.6
California	60.6	21.6	17.8	38.4	55.3	6.3	
Colorado	48.3	46.4	5.3	33.3	64.7	.5	1.5
Connecticut	18.4	71.4	10.2	83.7	11.7	4.6	
Delaware	80.0	20.0		40.0	57.5	2.5	
District of Columbia		100.0		100.0			
Florida	93.2	4.7	2.1	42.8	56.9	.3	
Georgia	68.8	28.4	2.8	63.8	35.1	.8	.3
Idaho	69.6	21.8	8.6	25.3	70.7	4.0	
Illinois	70.2	29.8		62.4	37.4		.2
Indiana	82.0	12.3	5.7	69.9	27.6	2.5	
Iowa	92.8	6.7	.5	46.3	51.6	1.9	.2
Kansas	83.1	15.1	1.8	49.0	49.7	1.3	
Kentucky	43.2	53.2	3.6	79.4	19.3	1.3	
Louisiana	83.3	16.3	.4	43.0	55.2	1.8	
Maine	25.4	67.9	6.7	76.2	22.3	1.5	
Maryland	49.1	20.7	30.2	74.8	25.2		
Massachusetts	41.1	39.5	19.4	54.0	33.5	12.2	.3
Michigan	75.1	23.8	1.1	39.1	59.6	1.3	
Minnesota	91.6	7.8	.6	30.8	66.9	2.3	
Mississippi	98.1	1.4	.5	29.2	70.8		
Missouri	63.1	35.8	1.1	62.3	37.7		
Montana	59.1	33.1	7.8	40.0	56.5	3.5	
Nebraska	97.8	2.2		7.6	92.2	.2	
Nevada	76.3	18.4	5.3	23.7	73.7	2.6	
New Hampshire	33.1	61.0	5.9	44.9	53.4	1.7	
New Jersey	57.9	22.4	19.7	71.8	12.9	14.9	.4
New Mexico	79.4	20.6		52.6	47.4		
New York	48.9	43.2	7.9	58.5	37.6	3.4	.5
North Carolina	47.2	51.4	1.4	66.7	32.8	.5	
North Dakota	89.2	9.0	1.8	16.2	82.9	.9	
Ohio	62.8	35.3	1.9	72.8	26.2	.8	.2
Oklahoma	72.1	25.9	2.0	39.9	59.8	.3	
Oregon	42.1	50.3	7.6	52.7	43.8	2.9	.6
Pennsylvania	31.4	55.3	13.3	84.8	11.9	3.3	
Rhode Island	51.4	45.9	2.7	73.0	27.0		
South Carolina	60.3	39.7		56.0	43.5	.5	
South Dakota	92.3	7.2	.5	28.2	70.8	1.0	
Tennessee	75.5	20.9	3.6	75.5	21.8	2.7	
Texas	81.9	15.6	2.5	36.9	60.1	1.2	1.8
Utah	86.5	9.5	4.0	11.5	88.0	.5	
Vermont	57.1	21.1	21.8	12.8	80.8	6.4	
Virginia	68.1	27.3	4.6	54.3	44.0	1.2	.5
Washington	60.7	31.2	8.1	37.3	61.6	1.1	
West Virginia	61.2	33.8	5.0	65.5	32.7	1.8	
Wisconsin	91.2	8.2	.6	31.8	67.0	1.2	
Wyoming	61.4	34.3	4.3	37.1	60.0	2.9	
Total	64.6	29.6	5.8	54.2	43.2	2.3	.3

Table 15. *Percent of communities and population served by source of supply and treatment—arranged by States*—Continued

State	Percent of total estimated population served by—			Percent of total estimated population served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment if any, not reported
Alabama	35.6	63.7	0.7	92.1	7.9		2.9
Arizona	55.9	5.9	38.2	79.1	18.0		Neg.
Arkansas	49.1	49.2	1.7	82.4	17.6		
California	28.9	24.6	46.5	76.1	18.6	5.3	
Colorado	12.9	84.3	2.8	85.0	14.4	.3	.3
Connecticut	2.3	91.1	6.6	98.4	.9	.7	
Delaware	35.5	64.5		72.5	16.8	10.7	
District of Columbia		100.0		100.0			
Florida	78.3	3.3	18.4	75.4	13.3	11.3	
Georgia	23.2	67.6	9.2	92.6	5.4	1.9	.1
Idaho	62.9	23.3	13.8	40.9	41.6	17.5	
Illinois	20.8	79.2		94.2	5.8		Neg.
Indiana	34.2	33.9	31.9	92.8	5.8	1.4	
Iowa	75.2	23.8	1.0	77.5	15.5	6.9	.1
Kansas	55.7	42.8	1.5	88.2	10.6	1.2	
Kentucky	14.6	83.0	2.4	96.5	3.0	.5	
Louisiana	40.3	59.7	Neg.	82.9	14.9	2.2	
Maine	8.1	83.2	8.7	93.9	4.8	1.3	
Maryland	7.8	84.4	7.8	98.1	1.9		
Massachusetts	13.8	74.8	11.4	87.3	6.8	5.9	Neg.
Michigan	24.8	73.8	1.4	88.4	10.5	1.1	
Minnesota	36.6	45.0	18.4	83.0	13.0	4.0	
Mississippi	73.0	21.6	5.4	70.7	29.3		
Missouri	13.5	83.4	3.1	94.6	5.4		
Montana	22.4	62.6	15.0	73.2	23.2	3.6	
Nebraska	65.3	34.7		54.8	44.3	.9	
Nevada	57.0	39.4	3.6	44.4	52.6	3.0	
New Hampshire	28.5	69.6	1.9	81.5	18.1	.4	
New Jersey	25.4	53.9	20.7	85.8	4.8	9.2	.2
New Mexico	82.5	17.5		77.6	22.4		
New York	8.6	27.3	64.1	34.1	3.5	62.4	Neg.
North Carolina	17.7	80.7	1.6	90.9	8.6	.5	
North Dakota	51.4	45.0	3.6	56.9	42.5	.6	
Ohio	28.1	70.3	1.6	92.8	4.3	2.9	Neg.
Oklahoma	30.3	65.8	3.9	82.8	17.2	Neg.	
Oregon	16.1	74.6	9.3	87.6	10.0	2.0	.4
Pennsylvania	9.4	69.6	21.0	95.8	2.2	2.0	
Rhode Island	7.4	92.2	.4	96.5	3.5		
South Carolina	26.9	73.1		85.0	12.9	2.1	
South Dakota	74.7	25.2	.1	64.8	27.7	7.5	
Tennessee	42.5	51.2	6.3	95.3	3.8	.9	
Texas	51.9	31.7	16.4	73.4	13.9	12.4	.3
Utah	60.5	2.5	37.0	53.5	46.5		
Vermont	21.6	49.0	29.4	48.1	35.9	15.7	
Virginia	14.5	76.5	9.0	92.9	5.7	1.3	.1
Washington	31.0	52.1	16.9	81.0	16.3	2.7	
West Virginia	36.5	59.8	3.7	90.7	18.2	1.1	
Wisconsin	46.7	51.3	2.0	74.9	24.3	.8	
Wyoming	53.3	30.4	16.3	71.3	25.0	3.7	
Total	26.0	54.6	19.4	79.6	9.3	11.0	.1

population receives water from ground sources. Neglecting the District of Columbia, where all the population connected to its system receives treated water, Connecticut with 98.4 percent of the total population receiving treated water has the highest percentage so served, closely followed by Maryland with 98.1 percent.

In 1948, 367 communities in 26 States were reported as receiving untreated water from surface sources. The population served by these supplies was about 285,000. New York which reported 49 communities had the largest number of such situations. This type of supply constituted 7.4 percent of the number of communities served by all surface supplies, but serves only 0.6 percent of the total population connected to surface sources.

Over 6,700 communities in which almost 8,300,000 persons were served are reported as being supplied with untreated water from ground sources. Every State reported systems of this type, and in only 10 States does the number of communities receiving treated ground water exceed those served by untreated water from ground sources. Untreated ground water supplies served 62.4 percent of the total communities served by ground sources, and 34.2 percent of the population. In fact, over 40 percent of all the communities in the United States having public water supplies were supplied with untreated ground water.

Population Groups

Practice with regard to supplies among communities of various size is shown in the percentage data of table 16. Places of under 5,000 population are served by ground sources in the majority of cases, while surface sources of supply are predominant in the large communities. About 65 percent of the places of less than 500 persons receive untreated water, and considering all communities receiving untreated water, over 96 percent are communities with less than 5,000 population. The percentage of communities receiving untreated water decreases rapidly with increasing community size, yet over one-third of the places in group 3 are served by untreated supplies. There are almost 7,000 communities of less than 5,000 population which receive untreated water.

With respect to population served, the same trends in practice are apparent as when number of communities is considered. In the smaller places, ground supplies are most common, and untreated water is supplied to the largest percentages of population served. In the larger communities, supplies de-

Table 16. *Percent of communities and population served by source of supply and treatment—arranged by population groups*

Population Group	Percent of total communities served by—			Percent of total communities served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment if any, not reported
Less than 500	75.8	21.1	3.1	33.6	64.9	1.1	0.4
500–1,000	73.7	22.4	3.9	45.8	52.6	1.2	.4
1,000–5,000	60.6	32.6	6.8	63.5	33.5	2.9	.1
5,000–10,000	45.8	44.1	10.1	78.9	16.2	4.8	.1
10,000–25,000	33.9	53.7	12.4	85.8	8.6	5.6	.....
25,000–50,000	26.3	61.5	12.2	91.0	4.1	4.9	.....
50,000–100,000	17.6	67.6	14.8	95.4	1.9	2.7	.....
More than 100,000	15.1	72.0	12.9	94.6	1.1	4.3	.....
Total	64.6	29.6	5.8	54.2	43.2	2.3	.3

Table 16. *Percent of communities and population served by source of supply and treatment—arranged by population groups*—Continued

Population Group	Percent of total estimated population served by—			Percent of total estimated population served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment if any, not reported
Less than 500	82.0	15.5	2.5	29.0	69.3	1.1	0.6
500–1,000	79.9	16.4	3.7	41.3	56.8	1.2	.7
1,000–5,000	62.6	31.3	6.1	63.4	32.8	3.7	.1
5,000–10,000	52.9	36.7	10.4	76.4	18.7	4.8	.1
10,000–25,000	39.4	48.3	12.3	86.1	8.6	5.3	.....
25,000–50,000	30.0	57.0	13.0	89.3	4.7	6.0	.....
50,000–100,000	18.9	63.1	18.0	93.9	2.8	3.3	.....
More than 100,000	6.5	65.5	28.0	81.9	.2	17.9	.....
Total	26.0	54.6	19.4	79.6	9.3	11.0	.1

pendent on surface sources serve the highest percentage of population, and the largest populations receive treated water. It is interesting to note that the 93 places of over 100,000 population, which comprise only 0.6 percent of the total number of communities having supplies, serve almost 50 percent of the total population served by public water supplies.

Of the 367 communities which are served by untreated surface supplies, more than half are communities of less than 500 population, and substantially all serve places of less than 5,000 persons. For those communities served by ground supplies, the number receiving untreated water predominates in the first three population groups, and the population receiving untreated ground water in these groups exceeds that served by treated supplies.

Geographical Areas

Percentage data for the nine geographical areas of the United States showing the number of communities and population served by source of supply and treatment, if any, are given in table 17. The wide variations, evident when the same data are considered by States, are smoothed considerably in

Table 17. *Percent of communities and population served by source of supply and treatment—arranged by geographical areas*

Geographical Areas	Percent of total communities served by—			Percent of total communities served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment if any, not reported
New England	35.9	51.4	12.7	58.0	36.3	5.6	0.1
Middle Atlantic	41.6	46.3	12.1	73.1	21.8	4.9	.2
South Atlantic	65.2	30.0	4.8	59.7	39.3	.9	.1
East North Central	73.9	24.5	1.6	57.5	41.4	1.0	.1
East South Central	67.5	30.2	2.3	68.1	30.9	1.0	.....
West North Central	87.6	11.6	.8	36.9	61.8	1.3	0
West South Central	79.4	18.7	1.9	40.9	57.1	1.0	1.0
Mountain	69.3	24.8	5.9	32.0	65.5	1.6	.9
Pacific	55.4	32.7	11.9	42.1	53.9	3.8	.2
Total	64.6	29.6	5.8	54.2	43.2	2.3	.3

Table 17. *Percent of communities and population served by sources of supply and treatment—arranged by geographical areas*—Continued

Geographical Areas	Percent of total estimated population served by—			Percent of total estimated population served by—			
	Ground sources	Surface sources	Both ground and surface sources	Treated supplies	Untreated supplies	Both treated and untreated supplies	Treatment, if any, not reported
New England	11.1	79.7	9.2	89.8	6.3	3.9	0
Middle Atlantic	11.6	45.6	42.8	62.9	3.3	33.8	0
South Atlantic	28.0	65.0	7.0	89.7	7.4	2.8	.1
East North Central	27.7	67.9	4.4	90.6	8.2	1.2	0
East South Central	37.3	59.4	3.3	91.1	8.6	.3	.....
West North Central	44.0	50.6	5.4	82.2	15.1	2.7	0
West South Central	46.2	43.9	9.9	77.6	15.0	7.3	.1
Mountain	44.7	39.1	16.2	70.3	26.5	2.7	.5
Pacific	27.9	33.8	38.3	78.0	17.4	4.6	0
Total	26.0	54.6	19.4	79.6	9.3	11.0	.1

this type of analysis. They present, furthermore, distinctive differences in water supply practice for the various areas of the country.

Nationally, the ratio of communities served by ground sources to those served by surface supplies is roughly 2:1. In the West North Central group this ratio is almost 8:1, while in the New England and Middle Atlantic States the percentage of communities served by surface supplies exceeds that served by ground sources. With the exception of the South Atlantic States, the 5 areas comprising the interior portion of the United States, have the largest number of ground supplies.

The West North Central and West South Central groups have the highest percentage (87.6 and 79.4 percent, respectively) of communities served by ground sources. With regard to treatment, in the four western groups of States; comprising all of the States west of the Mississippi River, the percentage of communities receiving untreated water exceeds that served by treated supplies. The lowest percentage of communities receiving untreated water is in the Middle Atlantic area, where 21.8 percent of the communities are so served.

In 7 of the 9 geographical areas, the percent of population served by surface supplies exceeds that served from ground sources. In the West South Central and Mountain groups, more people are served by ground supplies. In no instance does the population receiving untreated water exceed that served by treated supplies. The Mountain States, where over 26 percent of the population is served by untreated water, have the highest percentage.

Ownership

Data on the ownership of supplies show that in 68.9 percent of the communities the supplies are publicly owned, in 30.4 percent they are privately owned, and, in 0.7 percent of the communities the supplies are both publicly and privately owned. These percentages are based on the number of com-

Table 18. *Percent of communities served by publicly owned, privately owned and both publicly and privately owned water supplies—arranged by population groups, States, and geographical areas*

Population groups	Percent publicly owned	Percent privately owned	Percent publicly and privately owned
Less than 500	57.5	42.1	0.4
500–1,000	71.6	28.0	.4
1,000–5,000	73.2	26.3	.5
5,000–10,000	71.4	26.7	1.9
10,000–25,000	74.3	22.8	2.9
25,000–50,000	77.0	20.7	2.3
50,000–100,000	82.1	14.0	1.9
More than 100,000	84.8	8.7	6.5
STATES			
Alabama	59.7	40.3	
Arizona	35.6	64.4	
Arkansas	76.1	23.9	
California	65.0	33.8	1.2
Colorado	93.5	6.5	
Connecticut	28.9	68.8	2.3
Delaware	65.8	34.2	
District of Columbia	100.0		
Florida	53.6	44.3	2.1
Georgia	86.6	13.4	
Idaho	75.7	23.7	.6
Illinois	92.4	6.5	.1
Indiana	81.3	18.7	
Iowa	97.6	3.4	
Kansas	96.1	3.9	
Kentucky	61.1	38.9	
Louisiana	61.8	37.7	.5
Maine	43.2	56.8	
Maryland	68.8	31.2	
Massachusetts	82.6	16.6	.8
Michigan	81.1	18.6	.3
Minnesota	95.5	4.5	
Mississippi	77.4	22.6	
Missouri	75.1	24.9	
Montana	79.6	19.5	.9
Nebraska	99.3	.7	
Nevada	57.9	42.1	
New Hampshire	67.9	30.8	1.3
New Jersey	43.1	48.2	8.7
New Mexico	64.6	35.4	
New York	63.9	34.8	1.3
North Carolina	82.3	17.7	
North Dakota	98.2	1.8	
Ohio	91.3	8.7	
Oklahoma	93.9	6.1	
Oregon	67.9	30.9	1.2
Pennsylvania	32.0	66.8	1.2
Rhode Island	29.2	70.8	
South Carolina	65.5	34.5	
South Dakota	97.9	2.1	
Tennessee	69.7	30.3	
Texas	67.1	32.5	.4
Utah	72.7	27.3	
Vermont	49.0	48.4	2.6
Virginia	46.6	52.9	.5
Washington	68.2	31.0	.8
West Virginia	20.2	79.3	.5
Wisconsin	92.6	7.1	.3
Wyoming	80.0	18.6	1.4

Table 18. *Percent of communities served by publicly owned, privately owned and both publicly and privately owned water supplies—arranged by population groups, States, and geographical areas*—Continued

GEOGRAPHICAL AREAS	Percent publicly owned	Percent privately owned	Percent publicly and privately owned
New England	53.7	45.1	1.2
Middle Atlantic	45.8	51.9	2.3
South Atlantic	56.0	43.5	.5
East North Central	88.8	11.1	.1
East South Central	65.8	34.2	..
West North Central	94.1	5.9	....
West South Central	73.1	26.7	.2
Mountain	74.2	25.5	.3
Pacific	66.8	32.1	1.1
Total	68.9	30.4	.7

munities for which such data are available—more than 98 percent of the communities having water supplies.

Percentage data for each State, population group, and geographical area are shown in table 18. West Virginia has the highest percentage, 79.3, of private supplies, while Nebraska with less than 1 percent of its communities served by privately owned supplies is the lowest. Pennsylvania with 1,038 communities having privately owned supplies has the largest number and these constitute almost 21 percent of the total number of communities in the United States having privately owned supplies.

With regard to population groups, the largest percentage of privately owned supplies is in communities of less than 500 population. These percentages decrease with increasing community size. Conversely, the percentage of public supplies increase as the size of communities increase.

In group 1, the high percentage of communities served by privately owned supplies may be influenced unduly by the large number of mill villages and "company" towns in this group. There is the suggestion, however, that public development of water supplies for such small communities encounters problems which deter such action.

The highest percentages of privately owned systems are in the three areas bordering the Atlantic seaboard. The Middle Atlantic group with 51.9 percent of its communities served by private supplies has the highest percentage. The West North Central and East North Central groups, with 94.1 percent and 88.8 percent of communities served by public supplies, have the largest percentage of publicly owned supplies.

Comparison with Prior Data

Attempts have been made to compare general data on source and treatment from this study with previously reported information (*4*), (*7*), (*8*). These older data, with but one exception, are reported in terms of "water works." However, no firm definition of the term is given. This report has been pre-

pared on two distinct bases; (1) number of communities, and (2) number of treatment plants—the population served being included in both cases. Due to this difference, direct comparisons cannot be made except in selected instances.

Table 19, modified from *Water Supply Practice* (7), is presented for its historical value.

Table 19. *Growth in number of waterworks in the United States*

Year	*Number of works*
1800 [1]	16
1810	26
1820	30
1830	44
1840	64
1850	83
1860	136
1870	243
1880	598
1890	1,878
1896	3,196
1924	9,850
1934 [2]	10,790
1939 [3]	12,760

[1] Data for 1800 to 1924, inclusive, from *Manual of Water Works Practice* (8).
[2] From *Water Supply Practice* (7).
[3] From *Engineering News-Record* (4).

The *Engineering News-Record* survey (4) of 1939 indicated that almost 13,300 communities were served by water supplies in that year. Compared with 1948, this indicates an increase of over 3,400 places having community water supplies during the 9-year period. Considering that this period embraced war years, it appears that progress in new community supplies was as great, if not greater than during any other period in United States water supply history. Development of new systems was, of course, largely among the smaller communities. In 1939, there were more than 81,200,000 persons served by water supplies, as compared with almost 93,500,000 in 1948.

B. Treatment Plants

General

In 1948 there were almost 7,000 individual water treatment plants serving in excess of 83,200,000 persons. The majority of these plants, 51.3 percent, were simple disinfection plants. On a functional basis, the next largest number of plants was the class listed as *rapid sand purification*. This class comprised 25.0 percent of the total number of plants of all types. Populationwise, simple disinfection plants served 43.4 percent, and rapid sand purification plants, 40.6 percent, of the total served by all treatment plants. The percentages of total plants and population served for all functional classes of treatment plants are shown in table 2 (p. 4).

States

Pennsylvania reported the largest number, 650, of water treatment plants, while New York reported the greatest population served, more than 11,300,000. The percentages of plants in each functional category vary widely among the States, and such an analysis is not presented. Of more significance are the percentage data for population groups and geographical areas shown later in this report. All States and the District of Columbia have rapid sand purification plants, while 17 States and the District of Columbia have slow sand purification plants. Delaware is the only State reporting no simple disinfection plants. More than ¾ of the States have treatment plants incorporating softening, while Ohio has the largest number of plants classed as softening only.

Population Groups

Treatment plants, classified by groups based on the size of community in which they are located, show certain significant patterns of practice. A complete percentage analysis on this basis, both for number of plants and estimated population served, of all functional classes of plants is shown in table 20. The percentage of plants classed as rapid sand purification in-

Table 20. *Percent of total plants and population served for each type* of treatment within population groups*

NUMBER OF PLANTS—PERCENT

Type plant	Less than 500	500–1,000	1,000–5,000	5,000–10,000	10,000–25,000	25,000–50,000	50,000–100,000	More than 100,000	Total
Purification—rapid sand	11.6	14.9	26.1	34.2	38.0	44.5	49.0	37.2	25.0
Purification—slow sand	.9	.7	.9	.7	3.3	1.6	.....	8.2	1.2
Purification and softening	1.1	1.4	2.4	3.6	5.4	5.7	5.9	8.1	2.7
Purification and iron and manganese removal	.4	.3	.2	.3	.....	.5	.....	.....	.3
Purification, softening and iron and manganese removal	.....	.1	.1	.....	.4	1.5	1.9	.....	.2
Softening	2.7	6.0	5.3	5.9	4.8	2.6	2.0	1.6	4.9
Iron and manganese removal	10.1	10.9	8.6	4.2	6.9	3.7	1.0	4.3	8.3
Softening iron and manganese removal	1.6	4.9	3.9	3.1	2.0	1.5	.....	.....	3.3
Disinfection—alone or with miscellaneous processes	68.6	57.7	49.5	45.9	37.2	37.8	40.2	36.8	51.3
Miscellaneous	3.0	3.1	3.0	2.1	2.0	.6	.....	3.8	2.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

ESTIMATED POPULATION SERVED—PERCENT

Purification—rapid sand	14.9	16.7	34.7	37.3	39.9	45.2	53.4	40.1	40.6
Purification—slow sand	.6	.7	.8	.5	.3	1.2	.....	3.4	2.5
Purification and softening	.9	1.2	2.4	3.5	4.5	5.5	4.7	7.4	5.9
Purification and iron and manganese removal	.3	.3	.1	.3	.....	2.3	.....	.....	.2
Purification—softening and iron and manganese removal	.....	Neg.	.1	.....	.5	1.4	1.8	.....	.4
Softening	2.8	6.2	4.6	5.6	5.6	2.1	1.8	1.0	2.3
Iron and manganese removal	9.5	10.2	7.1	3.5	7.5	3.9	1.1	1.4	3.0
Softening, iron and manganese removal	1.6	4.1	2.8	3.2	2.1	1.5	.....	.....	.9
Disinfection—alone or with miscellaneous processes	66.9	57.7	44.4	44.5	35.2	36.7	37.2	46.3	43.4
Miscellaneous	2.5	2.9	3.0	1.6	1.7	.2	.....	.4	.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Based on primary function or functions.

creases directly with the size of community, while simple disinfection plants decrease in percentage as the size of community increases. Percentages of population for these two classes show the same general trends as do those for number of plants. The highest values for rapid sand purification plants are reached in group 7 where 49.0 percent of the plants serving 53.4 percent of the total population connected to all plants of this group are of this type. In group 1 simple disinfection plants comprise 68.6 percent of the total plants and serve almost 67 percent of the population. Softening plants are used most in plants serving communities of 500 to 25,000 population, while iron removal plants occur most frequently in communities of less than 5,000 population. Plants classed as both softening and iron removal show the same general pattern as is shown by softening plants alone, though the upper limit of community size is somewhat lower. In general percentage data for populations served follow those for number of plants.

Geographical Areas

Percentage data for the various functional classes of treatment plants analyzed by geographical areas are shown in table 21. There are wide

Table 21. *Percent of total plants and population served for each type* of treatment—within geographical areas*

NUMBER OF PLANTS—PERCENT

Type plant	New England	Middle Atlantic	South Atlantic	East North Central	East South Central	West North Central	West South Central	Mountain	Pacific
Purification—rapid sand	15.2	21.6	36.0	21.6	37.9	18.5	30.1	19.6	16.2
Purification—slow sand	6.7	2.9	.2	.3	.2	.....	.2	2.2	.....
Purification and softening	.....	1.3	1.7	4.9	.6	6.2	4.3	1.6	.7
Purification and iron and manganese removal	.5	.3	.4	.....	.4	.1	.2	.7	.....
Purification, softening and iron and manganese removal	.....	.....	.....	.9	.....	.1	.....	.....	.....
Softening	.2	2.2	5.4	9.8	2.8	10.9	1.8	1.9	1.9
Iron and manganese removal	3.4	3.3	8.1	11.1	8.6	20.6	9.1	.....	1.0
Softening, iron and manganese removal	.....	.2	1.9	11.1	.8	6.4	3.0	.....	.4
Disinfection—alone or with misc. processes	69.7	66.5	42.0	39.5	45.8	33.5	48.7	71.4	77.9
Miscellaneous	6.1	1.7	4.3	.8	2.9	3.7	2.6	2.6	1.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

ESTIMATED POPULATION SERVED—PERCENT

Purification—rapid sand	21.2	36.4	64.0	44.5	68.1	35.2	44.3	31.2	23.0
Purification—slow sand	8.6	3.1	5.0	.7	.1	.....	.1	4.8	.....
Purification and softening	.....	1.6	3.3	7.1	.2	29.9	15.8	2.2	1.0
Purification and iron and manganese removal	.1	.7	.2	.....	Neg.	Neg.	Neg.	Neg.	.....
Purification, softening and iron and manganese removal	.....	.....	.....	1.7	.....	Neg.	.....	.....	.....
Softening	Neg.	.9	5.3	3.3	1.5	6.8	.7	1.2	1.1
Iron and manganese removal	2.7	2.1	2.0	2.5	9.8	9.8	3.4	.....	.4
Softening, iron and manganese removal	.....	.2	1.2	2.0	.1	1.5	1.2	.....	.2
Disinfection—alone or with misc. processes	66.2	54.2	16.5	38.1	19.2	15.6	34.2	59.4	74.0
Miscellaneous	1.2	.8	2.5	.1	1.0	1.2	.3	1.2	.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Based on primary function or functions.

variations in practice among these areas, which undoubtedly reflect to large degree the varying characteristics of the available water supply in different parts of the country.

Considering number of plants, the South, including the South Atlantic, East South Central, and West South Central groups of States, has the highest percentage of rapid sand purification plants. This region also has the highest percentage of population served by this type plant. Slow sand purification plants are a significant type only in the New England area, where they comprise 6.7 percent of the plants and serve 8.6 percent of the population receiving treated water.

Softening plants and combined treatment including softening are most common in the East North Central and West North Central groups. Iron and manganese removal plants are also most common in these two areas.

Simple disinfection plants are the dominant type of treatment plants in all areas. They do not serve the largest populations, however, except in the Pacific, New England, Mountain, and Middle Atlantic groups, where 74.0, 66.2, 59.4, and 54.2 percent of the population, respectively, are served by this type of plant.

Comparison with Prior Data

In analyzing data on functional classes of treatment plants, Weibel (*3*) used data for 32 States which were fairly complete. To present comparable figures, these same 32 States have been separately tabulated in this study. The number of plants and population served in 1940 and 1948 for this group are given in table 22, as well as the present change occurring, and comparative percentage data for these States are shown in table 23.

Table 22. *Number of plants, population served and percent change for various types of treatment in 32* selected States in 1940 and 1948*

Type plant	Number of plants			Estimated population served		
	1940	1948	Percent change	1940	1948	Percent change
Purification—rapid sand	1,050	1,190	13.3	16,326,200	20,772,140	27.2
Purification—slow sand	60	50	—16.7	3,234,400	1,194,390	—63.1
Purification and softening	125	153	22.4	3,190,500	3,979,195	24.7
Purification and iron and manganese removal	6	13	116.7	180,500	192,280	6.5
Purification, softening and iron and manganese removal	0	1	.....	0	400	.....
Softening	199	262	31.7	1,000,600	1,192,710	19.2
Iron and manganese removal	331	418	26.3	1,117,800	1,353,665	21.1
Softening and iron and manganese removal	65	142	118.5	270,600	432,655	59.9
Disinfection—alone or with misc. processes	1,503	2,297	52.8	11,523,800	15,072,790	30.8
Miscellaneous	92	137	48.9	246,400	303,540	23.2
Total	3,431	4,663	35.9	37,090,800	44,493,765	20.0

*Alabama, Arkansas, California, Connecticut, Georgia, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Mexico, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming.

Table 23. *Percent of total plants and population served for various types of treatment in 1940 and 1948 for 32* selected States*

Type plant	Number of plants		Estimated population served	
	1940	1948	1940	1948
Purification—rapid sand	30.6	25.5	44.0	46.6
Purification—slow sand	1.7	1.0	8.7	2.7
Purification and softening	3.6	3.3	8.6	9.0
Purification and iron and manganese removal	.2	.3	.5	.4
Purification, softening and iron and manganese removal		Neg.		Neg.
Softening	5.8	5.6	2.7	2.7
Iron and manganese removal	9.7	9.0	3.0	3.0
Softening and iron and manganese removal	1.9	3.1	.7	1.0
Disinfection—alone or with misc. processes	43.8	49.2	31.1	33.9
Miscellaneous	2.7	3.0	.7	.7
Total	100.0	100.0	100.0	100.0

*See table 22.

Plants classified as combined softening and iron and manganese removal showed the greatest percentage increase in plants and population served during this period, but this type of treatment is still of only minor importance in the whole picture. Only one type plant, that of slow sand purification, showed a decrease in these States during the 8-year period. The increase in simple disinfection plants was considerable, 52.8 and 30.8 percent for change in number of plants and population served, respectively. This marked change produced changes in total practice as shown in table 23, where the percentage of total plants which are of the rapid sand purification type is less in 1948 than in 1940, even though there was an actual increase in numbers of this type during this period.

Data on the populations served by both slow and rapid sand filtration plants since 1870 are shown in table 24. As far as can be determined all data are comparable with the exception of the 1924 data where some population may be omitted, since that tabulation included only plants of greater than 1.0 M. G. D. capacity. It appears from these data that slow sand purification plants have declined in population served since 1914. In fact the

Table 24. *Total population served by slow and rapid sand type purification plants — 1870 to 1948*

Year	Slow sand purification plants	Rapid sand purification plants
1870 [1]	None	None
1880	30,000	None
1890	35,000	275,000
1900	360,000	1,500,000
1904	560,000	2,600,000
1910	3,883,000	6,922,000
1914	5,398,000	11,893,000
1924 [2]	5,054,000	18,610,000
1948	1,568,635	39,731,460

[1] Data for 1870 to 1914, inclusive from: Alvord, John W. *Recent progress and tendencies in municipal water supply practice in the United States*, J.A.W.W.A., 4:278-299 (1917).

[2] From: Gillespie, C. G. *Census of water filtration plants 1924*, J.A.W.W.A., 14:123-142 (Aug. 1925). This tabulation lists plants of 1.0 MGD capacity or larger.

population served in 1948 was less than one-third of that served by such plants in 1924. Rapid type plants have more than doubled in population served since 1924. While the exact period to which this increase can be definitely ascribed is not shown, it appears from the data of table 25 that a large proportion occurred prior to 1930. This table shows the number of

Table 25. *Number of purification plants of all types in 1924, 1930, 1940, and 1948*

States	Number of purification plants all types			
	1924 [1]	1930 [2]	1940 [3]	1948
Alabama	13	48	65	72
Arizona	0	2	3	7
Arkansas	11	28	30	36
California	9	19	38	40
Colorado	6	15	25	31
Connecticut	5	15	26	27
Delaware	2	1	3	3
District of Columbia	1		2	2
Florida	3	23	15	21
Georgia	13	50	74	79
Idaho	1	4	3	6
Illinois	33	77	104	113
Indiana	19	31	41	46
Iowa	12	24	33	35
Kansas	14	50	57	60
Kentucky	14	45	99	110
Louisiana	5	11	22	29
Maine	9	15	18	20
Maryland	10	13	16	16
Massachusetts	8	19	26	27
Michigan	18	28	42	43
Minnesota	9	19	18	19
Mississippi	4	9	4	4
Missouri	14	58	75	73
Montana	5	11	10	10
Nebraska	1	8	7	7
Nevada	0	0	3	6
New Hampshire	2	12	10	10
New Jersey	19	47	33	37
New Mexico	0	5	3	4
New York	39	96	126	136
North Carolina	43	86	96	106
North Dakota	5	6	11	13
Ohio	46	98	86	97
Oklahoma	25	56	68	73
Oregon	4	17	15	18
Pennsylvania	86	196	193	180
Rhode Island	5	8	8	9
South Carolina	16	29	40	58
South Dakota	3	8	8	11
Tennessee	13	36	37	48
Texas	23	47	73	94
Utah	0	2	3	2
Vermont	2	2	3	4
Virginia	26	72	59	71
Washington	7	9	8	14
West Virginia	22	51	91	99
Wisconsin	9	18	17	19
Wyoming	4	5	8	9
Total	638	1,529	1,855	2,054

[1] Data from Gillespie (6).
[2] Data from Streeter (5). These figures have been summarized from the basic data accompanying the summary report.
[3] Data from Weibel (3). These data include plants enumerated in the footnotes, but not shown in the tables.

purification plants of all types for various years between 1924 and 1940. Between 1924 and 1930 these data show an increase of 891 such plants, as compared with increases of 326 and 199 in the next 10 and 8 years, respectively.

C. Unit Facilities

General

A complete summary of data on various unit facilities common in American water works is presented in tables 12 and 13 (pp. 22, 24). These have been selected because of their frequent occurrence in practice. The data have not been tabulated in any great detail; that being proper to more specialized studies of an individual process.

Disinfection

In 1948, 6,137 water treatment plants serving more than 80,600,000 persons disinfected water at some stage of the treatment process. The process of disinfection is used in 87.8 percent of all treatment plants, and serves 96.9 percent of the population receiving treated water. In fact, 86.3 percent of the total population served by community water supplies receives water that has been disinfected.

Disinfection is, therefore, the largest unit process in use in United States water works. Disinfection usually connotes chlorination. In only two plants is the use of other disinfecting agents definitely reported. There is, however, a considerable group, 226 plants, for which the actual disinfecting agents have not been reported. On the basis of experience in receiving definitive data on this point, it appears warranted to assume for practical purposes, that these installations use chlorine as the disinfecting agent.

Liquid chlorine by itself is used at 3,613 plants serving more than 41 million persons. Chloramine treatment serves 33,500,000 persons in 702 plants, and hypochlorites are used at 1,557 plants serving about 1,700,000 persons.

In 15 States more than 90 percent of the total population served by water supplies is served by disinfected water. Maryland, with 98.0 percent receiving disinfected water, has the highest percentage of population, while Nevada with 45.9 percent, so served, has the lowest. In several States all treated water is disinfected. While these data show general overall conditions, and are interesting from this standpoint, attention is directed to the distribution among the population groups of the percentages of total population served receiving disinfected water. These data are shown in table 26.

The National average of 86.3 percent of those served by water supplies which receive disinfected water is exceeded in only three of the groups. These, with their large populations, influence greatly the National average. From this table, it may be inferred that the problem of extending disinfection service lies in the small communities. These areas, while developed

Table 26. *Percent of population served by water supplies receiving disinfected water—by population groups*

Population groups	Percent of total population receiving disinfected water	Population groups	Percent of total population receiving disinfected water
Less than 500	25.8	25,000–50,000	90.6
500–1,000	35.4	50,000–100,000	96.0
1,000–5,000	58.5	More than 100,000	97.0
5,000–10,000	74.3		
10,000–25,000	84.4	Total	86.3

greatly in the past few years, as noted later in this report, present fertile fields for the development of increasingly safe community water supplies.

Differences in practice among the States can be noted from table 12. In some States, the use of liquid chlorine is predominant, while in others, chloramine disinfection serves the largest population. These data are, of course, influenced greatly by practice in the larger cities. Of more significance is the division of practice among the population groups and geographical areas. Percentage data for various types of disinfection within each population group are given in table 27, and by geographical areas in table 28.

Certain significant facts are apparent from table 27. The use of hypochlorites predominates in plants serving communities of less than 1,000 population; use of liquid chlorine increases to a maximum in group 4 and falls off as community size increases; and, chloramine treatment increases slowly, having its greatest use in plants serving communities of more than

Table 27. *Percent of plants and population served by various types of disinfecting agents—within population groups*

Type disinfecting agent	(Population Groups)								
	Less than 500	500-1,000	1,000-5,000	5,000-10,000	10,000-25,000	25,000-50,000	50,000-100,000	More than 100,000	Total
	(Number of plants—percent)								
Liquid chlorine	32.1	45.2	68.9	73.1	64.3	54.3	50.0	51.4	58.9
Hypochorite	63.6	48.3	19.0	4.2	2.7	.5	.....	.6	25.4
Ammonia—chlorine	.5	2.7	7.8	17.5	29.3	39.9	41.2	44.0	11.4
Unspecified	3.5	3.2	3.6	4.3	3.5	3.2	7.8	4.0	3.7
Both liquid chlorine and hypochlorite	.3	.5	.7	.9	.2	2.1	.....	.....	.6
Others	.....	.1	.....	.....	.....	.....	1.0	.....	Neg.
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	(Estimated population served—percent)								
Liquid chlorine	37.5	49.5	68.9	73.6	64.3	52.1	48.7	44.0	51.2
Hypochlorite	56.7	43.7	11.7	2.9	2.3	Neg.	.....	Neg.	2.1
Ammonia—chlorine	.6	3.3	15.6	19.2	30.4	43.1	45.1	50.2	41.6
Unspecified	5.1	2.7	2.9	3.6	2.8	1.8	4.6	5.8	4.6
Both liquid chlorine and hypochlorite	.1	.7	.9	.7	.2	3.0	.....	.....	.4
Others	.....	.1	.....	.....	.....	.....	1.6	.....	.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

100,000. The use of hypochlorites in plants serving communities of more than 5,000 population is quite minor. At the same time chloramine disinfection serves only a small portion of the population in communities of less than 1,000 persons.

Considering numbers of plants, the percentage data of table 28 present the same hazards as when individual States are compared, the large numbers of plants in the smaller population groups screen true differences in practice among the several geographical areas. The data for population served of this table are, however, quite indicative of variations in practice among the various regions. With the exception of the Pacific States, where the number

Table 28. *Percent of plants and population served by various types of disinfecting agents within geographical areas*

Type disinfecting agent	Geographical Areas									
	New England	Mid-Atlantic	South Atlantic	East North Central	East South Central	West North Central	West South Central	Mountain	Pacific	Total
	(Number of plants—percent)									
Liquid chlorine	54.6	52.3	63.6	64.9	59.7	55.1	72.8	59.2	41.6	58.9
Hypochlorite	31.4	27.0	23.6	21.9	30.0	29.0	20.1	25.0	23.2	25.4
Ammonia chlorine	12.6	13.2	10.6	12.1	7.1	13.3	6.6	12.0	15.4	11.4
Unspecified	1.1	5.8	1.5	.8	3.0	2.5	.5	3.8	19.1	3.7
Both liquid chlorine and hypochlorite	.3	1.6	.7	.3	.....	.1	.....	.....	.7	0.6
Others	.....	.1	.....	.....	.2	.....	.....	.....	.....	Neg.
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	(Estimated population served—percent)									
Liquid chlorine	54.5	68.9	52.4	35.9	55.9	41.9	63.3	60.5	21.5	51.2
Hypochlorite	3.2	2.0	2.4	1.1	4.2	2.6	2.0	4.5	1.0	2.1
Ammonia chlorine	41.9	25.6	44.7	61.7	39.4	53.8	34.6	32.6	39.0	41.6
Unspecified	.4	1.7	.4	1.1	.5	1.7	.1	2.4	38.4	4.6
Both liquid chlorine and hypochlorite	Neg.	1.2	.1	.2	.....	Neg.	.....	.....	.1	.4
Others	.....	.6	.....	.....	Neg.	.....	.....	.....	.....	.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

of plants for which disinfection details are lacking is quite large, the data are quite comparable. It is indicated that liquid chlorine as the disinfecting agent serves the highest percentage of population in the Middle Atlantic States. Chloramine treatment predominates in the East North Central group, and this area has the smallest percentage of persons served by liquid chlorine as the sole disinfection agent of any of the groups, the Pacific States excepted. The Mountain and East South Central groups have the largest percentages of population served by hypochlorites, 4.5 and 4.2 percent of the total, respectively, of all the areas.

Comparisons with 1930 and 1940

In table 29 the total numbers of plants providing disinfection are given for the years 1930, 1940, and 1948. Data by various methods of disinfection

Table 29. *Comparison of number of plants in 1930, 1940 and 1948 having disinfection, and by various methods in 1940 and 1948—by States*

States	Total			Liquid chlorine		Hypochlorite		Ammonia chlorine		Unspecified	
	1930	1940	1948	1940	1948	1940	1948	1940	1948	1940	1948
*Alabama	80	162	187	88	87	70	99	4	1	...	...
Arizona	6	23	34	11	20	4	19	4	4	4	1
*Arkansas	26	59	80	41	60	11	14	2	5	5	1
California	83	120	150	20	41	2	6	20	25	78	78
Colorado	29	34	56	6	44	...	9	...	...	28	3
*Connecticut	41	73	88	50	56	15	26	6	6	2	...
Delaware	1	3	6	3	6	...	...	...	...	...	...
District of Columbia	...	2	2	...	...	...	...	2	2	...	...
Florida	37	46	130	3	75	1	25	16	22	26	8
*Georgia	98	155	189	115	127	23	42	12	19	5	1
Idaho	20	19	52	...	29	...	18	4	5	15	...
*Illinois	109	193	252	142	174	13	39	37	37	1	2
*Indiana	91	[7] 183	248	116	164	42	61	22	21	...	2
*Iowa	77	111	183	76	90	20	78	8	8	7	7
*Kansas	59	84	[8] 181	46	78	15	75	23	24	...	3
*Kentucky	83	170	182	113	121	24	24	22	23	11	14
*Louisiana	12	36	79	22	50	11	22	3	7	...	...
*Maine	70	[9] 96	[10] 101	52	47	22	32	21	21	...	...
Maryland	36	42	[11] 63	...	24	...	30	6	5	36	1
Massachusetts	35	70	90	26	57	3	13	7	16	34	4
*Michigan	72	[12] 92	121	54	75	6	28	28	16	3	2
*Minnesota	38	42	71	23	37	2	14	16	20	1	...
Mississippi	10	25	54	2	26	...	21	1	4	22	3
*Missouri	83	[13] 107	129	80	104	2	7	22	16	2	2
*Montana	31	46	48	21	24	9	9	14	14	2	1
Nebraska	13	19	16	4	7	4	2	3	8	8	4
*Nevada	2	8	11	4	6	1	2	2	2	1	1
*New Hampshire	20	33	39	19	18	13	21	...	...	1	...
New Jersey	80	143	[14] 193	...	72	...	52	29	36	114	28
*New Mexico	7	14	35	7	21	4	14	3	...	...	...
*New York	195	[1] 407	[2, 15] 453	218	228	96	109	81	85	12	26
*North Carolina	107	147	173	107	116	12	26	28	31	...	...
North Dakota	11	14	16	3	9	1	...	5	7	5	...
*Ohio	101	[16] 142	[17] 211	109	131	11	56	21	22	...	1
Oklahoma	84	103	129	7	88	5	25	10	16	81	...
*Oregon	86	85	[18] 138	55	68	13	50	17	19	...	...
Pennsylvania	502	[3] 596	[19] 638	313	372	133	185	56	49	94	20
*Rhode Island	8	17	25	11	7	4	15	2	3	...	...
South Carolina	29	49	81	6	66	4	5	16	9	23	1
*South Dakota	17	29	52	16	32	1	12	9	8	3	...
Tennessee	75	[3] 117	[6] 141	79	103	17	25	10	12	11	...
*Texas	108	191	318	140	243	23	61	19	12	9	2
*Utah	8	22	20	14	13	1	...	6	6	1	1
*Vermont	6	6	[20] 23	6	15	...	8	...	...	...	...
*Virginia	72	152	190	92	103	42	73	11	11	7	1
*Washington	9	89	[21] 121	59	61	17	39	12	19	1	...
West Virginia	109	202	[22] 234	146	162	21	51	13	14	22	4
*Wisconsin	33	[23] 59	[24] 68	35	40	10	13	13	13	...	...
Wyoming	8	13	26	3	16	...	2	2	4	8	4
Total 48 States	2,917	[4] 4,650	6,137	2,563	3,613	728	1,557	668	702	683	226
*Total, 30 States	1,749	3,010	4,016	1,931	2,396	533	1,069	464	469	74	67

*30 States having lowest percentages of unspecified disinfection. See table 30.

[1] Reported as 365 in Reprint 2416, PHR (3). Basic data were resummarized.

[2] Reported as 588 in Reprint 2416, PHR (3). Basic data were resummarized.

[3] Reported as 107 in Reprint 2416, PHR (3). Basic data were resummarized.

[4] Reported as 4,590 in Reprint 2416, PHR (3). See notes 1, 2, and 3.

The following plants having disinfection by some means other than that employing chlorine are not shown in the detail data:

[5] 1 plant. [6] 1 plant.

Table 29. Footnotes—*Continued on page 48*

are given, but only for 1940 and 1948. The data for 1930 were summarized from the basic data of the report by Streeter (*4*). All of the data for 1940 were resummarized from the basic data, and the differences from the published report (*3*) have been noted in the footnotes. Population data have not been summarized from the earlier reports. The detail work involved, and a lack of specific data in so many cases, showed the advantages to be of questionable significance.

Table 29 presents data concerning changes in total numbers of plants providing disinfection in 1930, 1940, and 1948, for each State. Changes occurring between 1940 and 1948 have been analyzed in table 30 by various specific type of disinfection for 30 selected States as noted in table 29. These States were selected since they represent the most completely reported practice for both years. Various checks have been applied to this procedure to test its validity for indicating trends, and its use appears well justified. These 30 States represented 64.7 percent of the total plants providing disinfection in 1940, and 65.4 percent in 1948. The percent change in total plants providing disinfection for the United States between 1940 and 1948 was 32.0 percent. For these 30 States it was 33.4 percent. The percentage of unspecified type of disinfection in plants of these 30 States was 2.5 percent in 1940 and 1.7 percent in 1948. Using these parameters of comparison with total United States practice and with themselves, the use of these 30 States for indicating trends in National practice appears to be satisfactory.

In the decade 1930 to 1940, the number of plants providing disinfection increased 1,733, a change of almost 60 percent. Between 1940 and 1948, 1,487 more plants using disinfection were reported; a change of 32.0 percent. Thus, between 1930 and 1948, the number of plants providing disinfection more than doubled—an increase of 100 percent. While comparative data for other unit processes are not available, it appears likely that no other single process has enjoyed such an increase in total number of installations.

In the 30 selected States for the period 1940–1948, the number of plants using liquid chlorine as the disinfecting agent increased by about 24 percent, and the number utilizing hypochlorites increased over 100 percent. The number of plants using chloramine disinfection increased only by 5 or 1.1 percent in the 1940–48 period. In many States there was a substantial decline in the number of plants using this treatment. In 9 of the 30 States considered there was no change in the number of plants using chloramines.

The number of plants using hypochlorites more than doubled between 1940 and 1948 in these 30 States. This is undoubtedly due to the extension

Table 29. Footnotes—*Continued from page 47*

The following plants having disinfection with both liquid chlorine and hypochlorite are not shown in the detail data:

[7] 3 plants.
[8] 1 plant.
[9] 1 plant.
[10] 1 plant.
[11] 3 plants.
[12] 1 plant.
[13] 1 plant.
[14] 5 plants.
[15] 4 plants.
[16] 1 plant.
[17] 1 plant.
[18] 1 plant.
[19] 12 plants.
[20] 2 plants.
[21] 2 plants.
[22] 3 plants.
[23] 1 plant.
[24] 2 plants.

Table 30. *Change in number of plants and percent increase or decrease between 1940 and 1948 for various disinfection methods*

States	Total		Liquid chlorine		Hypochlorite		Ammonia chlorine	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama	25	15.4	−1	−1.1	29	41.4	−3	−75.0
Arizona	21	91.3						
Arkansas	21	35.6	19	46.3	3	27.3	3	150.0
California	30	25.0						
Colorado	22	64.7						
Connecticut	15	20.5	6	12.0	11	73.3	0	0
Delaware	3	100.0						
District of Columbia	0	0						
Florida	84	182.6						
Georgia	34	21.9	12	10.4	19	82.6	7	58.3
Idaho	33	173.7						
Illinois	59	30.6	32	22.5	26	200.0	0	0
Indiana	65	35.5	48	41.4	19	45.2	−1	−4.5
Iowa	72	64.9	14	18.4	58	290.0	0	0
Kansas	97	115.5	32	69.6	60	400.0	1	4.3
Kentucky	12	7.1	8	7.1	0	0	1	4.5
Louisiana	43	119.4	28	127.3	11	100.0	4	133.3
Maine	5	5.2	−5	−9.6	10	45.5	0	0
Maryland	21	50.0						
Massachusetts	20	28.6						
Michigan	29	31.5	21	38.9	22	366.7	−12	−42.9
Minnesota	29	69.0	14	60.9	12	600.0	4	25.0
Mississippi	29	116.0						
Missouri	22	20.6	24	30.0	5	250.0	−6	−27.3
Montana	2	4.3	3	14.3	0	0	0	0
Nebraska	−3	−15.8						
Nevada	3	37.5	2	50.0	1	100.0	0	0
New Hampshire	6	18.2	−1	−5.3	8	61.5		
New Jersey	50	35.0						
New Mexico	21	150.0	14	200.0	10	250.0	−3	−100.0
New York	46	11.3	10	4.6	13	13.5	4	4.9
North Carolina	26	17.7	9	8.4	14	116.7	3	10.7
North Dakota	2	14.3						
Ohio	69	48.6	22	20.2	45	409.1	1	4.8
Oklahoma	26	25.2						
Oregon	53	62.4	13	23.6	37	284.6	2	11.8
Pennsylvania	42	7.0						
Rhode Island	8	47.1	−4	−36.4	11	275.0	1	50.0
South Carolina	32	65.3						
South Dakota	23	79.3	16	100.0	11	1,100.0	−1	−11.1
Tennessee	24	20.5						
Texas	127	66.5	103	73.6	38	165.2	−7	−36.8
Utah	−2	−9.1	−1	−7.1	−1	−100.0	0	0
Vermont	17	283.3	9	150.0	8			
Virginia	38	25.0	11	12.0	31	73.8	0	0
Washington	32	36.0	2	3.4	22	129.4	7	58.3
West Virginia	32	15.8						
Wisconsin	9	15.3	5	14.3	3	30.0	0	0
Wyoming	13	100.0						
48-State total	1,487	32.0						
Total 30 States	1,006	33.4	465	24.1	536	100.6	5	1.1

of disinfection processes into the smaller treatment plants. While pertinent population data are not available to support this, a check of table 12 shows that plants employing hypochlorites are the major types in plants serving communities of less than 1,000 population.

Filtration

Gravity rapid-sand filtration is reported in use at 2,106 plants serving more than 39 million persons. Ohio has the largest number of installations, in

177 plants, and Pennsylvania with over 4 million population has the greatest population served by this type filter. Rapid sand filters are used in over 30 percent of all treatment plants serving 47.0 percent of the total population receiving treated water. Utah is the only State from which no installation of this type was reported.

Percentage data by population groups showing the use of gravity rapid-sand filters are given in table 31. The use of this type of filter increases as the size community increases. In group 1 only 11.6 percent of the treatment plants have gravity rapid-sand filters, but this increases to almost 57 percent of the plants in group 7. Percentage data for population served indicate the same general trends as are shown in table 31.

Table 31. *Percentage of all treatment plants having various unit process—arranged by population groups and geographical areas*

Population groups	Proportion of all treatment plants having—			
	Gravity rapid—sand filters	Aeration	Taste and odor control	Corrosion control
	Percent	*Percent*	*Percent*	*Percent*
Less than 500	11.6	13.9	0.6	9.3
500–1,000	18.1	21.6	3.2	12.4
1,000–5,000	31.8	23.0	9.8	12.4
5,000–10,000	40.8	21.8	16.6	18.6
10,000–25,000	48.7	24.8	22.1	18.8
25,000–50,000	53.4	31.1	30.1	21.8
50,000–100,000	56.9	23.5	38.2	27.5
More than 100,000	43.2	17.8	19.5	25.9
Geographical areas				
New England	12.7	11.5	5.3	23.3
Middle Atlantic	19.8	11.4	10.7	10.6
South Atlantic	39.5	20.7	11.1	24.5
East North Central	37.6	28.8	15.9	12.7
East South Central	40.1	22.6	8.5	18.4
West North Central	35.4	40.7	11.2	17.5
West South Central	35.1	30.8	7.2	2.0
Mountain	16.1	2.3	5.5	2.9
Pacific	12.5	8.7	5.2	3.8
Total	30.1	21.7	10.3	14.0

More than 80 percent of the slow-sand filter installations are in the New England and Middle Atlantic States. They are reported to be in use at almost 10 percent of all treatment plants in the New England area. While New York has the largest number of installations, in 34 plants, of this type, Pennsylvania has the greatest population, over 1,400,000, so served.

Almost 90 percent of the pressure sand filter installations are in plants serving communities of less than 5,000 population, however, only in group 1 does the number of plants having pressure filters exceed those having gravity rapid-sand filters.

Anthracite media in rapid-type filters is reported in use at 52 plants serving in excess of 1,400,000 persons. Pennsylvania has the largest number of such installations among the States, and the South Atlantic States among the geographical areas.

Table 32. *Number of softening plants for the years 1941, 1944, and 1948—arranged by population groups*

Population groups	Number of softening plants		
	1941 [1]	1944 [2]	1948
Less than 1,000	147	194	217
1,000–5,000	240	272	348
5,000–10,000	79	88	94
10,000–50,000	87	87	92
More than 50,000	23	24	28
Total	576	665	779

[1] From Olson (9).
[2] From Olson (*10*).

Softening

Softened water is furnished to more than 8,300,000 persons from 779 plants. The chemical precipitation process of softening is the more common; being used in 61.7 percent of all such plants and serving almost 90 percent of the total population receiving softened water. Zeolite softening plants are used more in the smaller communities and comprise about 46 percent of the softening plants serving communities of less than 5,000 population.

In 1948, Ohio reported 141 plants at which softening was practiced. Ohio also reported the largest population, over 1,200,000, served by softened water. Ten States reported no such plants.

Almost 40 percent of the plants having softening processes are located in the East North Central group of States. These States plus those in the West North Central group have over 65 percent of such plants. Only one plant employing softening is reported from the New England States. The importance of water softening problems in the various regions of the country is strikingly shown in the geographical area data of table 13.

In table 32 data are given for numbers of softening plants reported for various years since 1941, and by type of softening process in table 33. A trend toward increasing use of the zeolite softening process is apparent. In 1940, zeolites were used in 31.1 percent of all softening plants, while in 1948

Table 33. *Number of plants softening by chemical precipitation and zeolites for 1940, 1941, 1944, and 1948*

Year	Number of softening plants—		Percent of total plants softening by—		
	Chemical	Zeolite	Total	Chemical precipitation	Zeolites
1940 [1]	377	170	547	68.9	31.1
1941 [2]	377	199	576	65.5	34.5
1944 [3]	427	238	665	64.2	35.8
1948	481	298	779	61.7	38.3

[1] From Weibel (3).
[2] From Olson (9).
[3] From Olson (*10*).

they were used in over 38 percent of these plants. This is undoubtedly due to the increase in the number of softening plants serving communities of less than 5,000 persons.

Aeration

Aeration of water is practiced in 1,518 plants; about 22 percent of all treatment works. These plants serve almost 17,700,000 persons. The percentage of all treatment plants using this process by population groups and geographical areas are given in table 31. Significant differences in practice are noted among the various areas of the country. In the four groups of States comprising the Central portion, the practice exceeds the National percentage. In the West North Central group 40.7 percent of all treatment works have aeration devices.

Taste and Odor Control

Over 10 percent of the treatment works in the United States are reported to employ taste and odor control procedures, and they serve 22.3 percent of the population receiving treated water. The percentage of total plants having taste and odor control increases as the size of community served to a maximum of over 38 percent in group 7. This falls off to less than 20 percent in group 8. Percentage data for taste and odor control measures are also given in table 31. In the East North Central States, 15.9 percent of all plants employ taste and odor control procedures, while in the Pacific States only 5.2 percent of the plants use such processes.

Corrosion Control

In 1948, 980 plants were reported to use corrosion control processes. As with taste and odor control, the use of these procedures increases in percentage of total plants as the size of the community increases. Corrosion control methods are used most frequently in the South Atlantic area, where almost 25 percent of the treatment works have such processes. The use of these processes is quite limited in the West South Central, Mountain and Pacific areas, especially when compared with practice in the rest of the country. Percentage data for population groups and geographical areas are shown in table 31.

Acknowledgment

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